THE

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THE BOARD OF TRADE REGULATIONS.

ELSEWHERE we print in full the revised Board of Trade regulations for electric lighting. On the whole they are satisfactory; but as was anticipated, the distinction between alternating and continuous current has been persistently maintained.

This distinction, as has been repeatedly pointed out, should not be made so sweeping, unless evidence of a reliable character, proving the greater danger of alternating currents, is satisfactorily established. Why, in the name of common sense, should such a distinction be made, and an onerous restriction be placed upon alternating currents without sufficient cause, and why should continuous currrent supply be thus favoured? This can only be answered, if it can be answered at all, by the committee of experts who sat in camera to discuss this most important question. It is obviously their duty to the whole section of the profession who are interested in alternating current, as well as to the public generally, that a full and public explanation should be given.

In Clause 4 (which was Clause 7 in the draft regulations) it will be found that the objectionable "Automatic cut-out" section has been deleted, as was promised by Sir Courtenay Boyle, thus making the clause reasonable and workable.

Clause 10 (Clause 13 in the draft regulations) has also been modified as promised, and only in the case of cables is it necessary to test to twice the working pressure. This is reasonable, and it is customary for many, if not all, cable manufacturers to subject their cables to a similar test before delivery. The reduction of the test pressure in the case of machines or apparatus to 50 per cent. above the maximum required in practice, is a fair and reasonable concession.

Clause 13, which originally stood as clause 4 in the draft regulations, has also been modified. Instead of a high pressure line being limited to the transmission of 200,000 watts, it can now be used up to 300,000 watts, a matter of very great convenience in many cases, and a great concession on the part of the Board of Trade, who were anxious to make it as low as possible.

Clause 15 requires all accidents to be reported to the Board of Trade, but as an Act already exists, it seems somewhat superfluous.

Clauses 27 and 34, dealing with the gas question, is very satisfactory. The objectionable word "influx" has had its sting removed, and the undertakers are now only required to provide means for preventing accumulations of gas in conduits and boxes, and to give notice to the gas companies.

If the Board of Trade will now go further, and seek means whereby gas and electric lighting undertakings may be placed upon an equal footing, with equal restrictions, they will not only earn the hearty thanks of all electric lighting un-

dertakers, but they will also perform an obvious duty to the public.

Things are quiet in the gas explosion line just at present —at least, in electric conduits—and we sincerely hope this satisfactory condition of affairs may so continue. At any moment, however, trouble may arise, for the gas is always with us, and only seeks an opportunity to trespass on forbidden ground, and we hope the Board of Trade will take some decisive preventive measures, without delay, and not wait for further trouble.

In the old regulations, a clause was provided (Clause 24) making it compulsory, on the part of the undertakers, to disconnect any consumer's installation when the total insulation resistance did not exceed 5,000 ohms. At the Westminster Town Hall considerable discussion took place on this point, the unanimous opinion being that the figure should be much higher, and that a further clause should be inserted prohibiting undertakers from connecting any premises unless the insulation was equal to 50 or 75 (different opinions) megohms per lamp. Sir Courtenay Boyle seemed to favour the suggestion, and concluded his remarks as follows:—"I will consider what the amount shall be. I will deal with the clause in this way—that the undertakers are not to be obliged to connect up unless the insulation resistance is *x—somewhere about what has been suggested;* and that they must cut off if it fall below another *x*."

Now, the lowest figure mentioned was 50 megohms per lamp. It is therefore with considerable surprise that we find Clauses 41 and 42 only prevent connection and enforce disconnection in the event of a leakage being discovered equal to one ten-thousandth part of the maximum supply current to the premises. This equals about 1·6 megohms per 60-watt 100-volt lamp, and represents in the case of large installations very little improvement on the old clause. Why this insulation should be made so low it is difficult to see, when the matter is one not only for the protection of the undertakers, but also of the public against bad wiring.

CABLE DEFENCE SCHEME.

THE series of three articles which *Invention* has published on the above scheme came to a close last Saturday, and a note appended by the editor invites criticism from naval men, electrical engineers, and others interested in naval defence.

The problem which Mr. Scott Snell set himself was the providing of machinery capable of paying out a specially designed cable at the maximum speed attained by the fastest cruisers, say 20—30 knots. It is to this practical part of the scheme that we shall confine ourselves. We need hardly remind our readers that a speed of 30 knots is nearly three times as great as that at which a telegraph cable has ever been paid out with the usual appliances. Mr. Scott Snell, therefore, proposes to employ machinery differing totally from any existing kind. Instead of carrying the cable in a circular tank, he coils it on an enormous drum or bobbin, 60 feet in length and 20 feet in diameter, weighing when filled with 300 miles of cable, considerably over 200 tons. This drum is placed in the ship with its axis longitudinally, and is rotated by means of special machinery at such a speed as always to allow some slack cable to pass out, the speed of the vessel being determined by a log. The special type of cable proposed is thus described by an eminent manufacturer, who, it is stated, had full knowledge of the circumstances. "To consist of seven No. 22 tinned copper wires, and having No. 20 sheathed steel wires. Diameter, 0·45 inch, weight per knot, 11·4 cwt. in air, and 8·75 cwt. in salt water." We hope for the credit of the eminent manufacturer that he has been seriously misquoted. For 300 miles of this cable, Mr. Snell provides 14,100 cubic feet of space; 2,300 cubic feet would, we venture to say, be ample. But, apart from trivial mistakes of this kind, we are sorry to say that we cannot agree with any of the methods of procedure adopted. It is well known to cable experts that at speeds even approaching the half of 30 knots, to give slack in shallow water the cable must actually be deposited on the surface of the water slack, and yet Mr. Snell expects to get slack after allowing his cable to pull itself out round several intermediate wheels placed between the power-rotated bobbin and the ship's stern. But, perhaps, the most unpardonable mistake of all is to imagine that the speed of a ship going at a high rate can be determined with anything like accuracy by a log. At the best, a log can only give the speed of the ship through the water, and this without certain knowledge of the direction and force of tides and currents is of little use in enabling the desired amount of slack cable to be given. There is only one way of measuring accurately the speed of a ship overground when out of sight of land, and that is by paying out a taut steel measuring wire. But we are not at all sure that for the purposes in question any slack would be necessary. It is true that paid out at a high speed, a cable would sink practically horizontally, but there are few irregularities of bottom so sudden as would involve the suspension of such a length of cable as would be likely to cause a breakage in the short time during which it would be required to hold out.

It may be difficult, but it is by no means impossible to pay out a cable from a ship steaming at a speed of 30 knots, but we should certainly not recommend any such methods as Mr. Snell proposes. Given a properly constructed type of cable, and sufficient space in which to stow it in a properly constructed tank, it is very possible that the cable would pay itself out better without any machinery whatever. The reason why submarine cables are generally paid out slowly and carefully, is not because arrangements could not be made to enable a much greater speed to be attained with safety, if desirable, but because a high speed means an angle of descent nearly approaching the horizontal, and a cable so sinking cannot possibly accommodate itself properly to the irregularities of the bottom.

A Happy Medium Desirable.

THE determination of a few of the manufacturers of china and porcelain materials to combine for the purpose of remedying the present unremunerative prices charged for these goods is right and proper, provided it has not the effect of raising prices to an unnecessarily high standard. As will

be observed from our "Notes" columns, manufacturers interested have been constantly conferring together lately concerning the matter, and an association has been formed for this and other worthy objects. In altering prices, however—and we fully grant that at present they are so seriously unprofitable as to need alteration—there are two exceedingly important points which must be well considered in the manufacturers' own interests. Firstly, we believe it will be found very difficult to complete any proposed ring. The other vital point is that our position in England, as compared with certain Continental countries in manufacturing porcelain goods, is such that certain of our special qualities ensure a good supply of orders from colonial and other quarters so long as the price is reasonable, but, if the prices are unduly raised, then it must be expected that Germany and France will carry off a good portion of the orders which now come to Staffordshire from foreign countries. The matter should be well weighed on these points in order to avert a disaster to the Staffordshire trade.

The New Photography.

Prof. Puluj, of the Technical High School, at Prague, has recently succeeded, with the help of a professional photographer, in producing some very fine Röntgen photographs. These photographs were not merely so-called "shadowgraphs," but showed in finest detail the variations in density and thickness of the objects subjected to the action of the Röntgen rays. Feathers and quills having proved very transparent, it was found possible to photograph the bony skeleton and soft parts of a bird through the feathers. The fins and bones of a sprat also came out very distinctly. On January 19th, Prof. Puluj photographed in his laboratory parts of the body affected with tuberculosis. The pictures showed very distinctly, not only the contractions and displacements of the diseased bones, but the shading also showed what parts of the bones had not yet been attacked. He feels confident of being able by improved arrangements to considerably reduce the present somewhat too long exposure. M. Jean Perrin has been investigating the Röntgen radiation, and has confirmed the results of the discoverer as to the absence of reflection, refraction, and diffraction when the ordinary means are employed. He concludes they are not cathode rays "because these latter cannot, in fact, issue from the vacuum tube except through a wall some microns in thickness, whilst Röntgen rays act easily out of a tube, the side of which may have a thickness of 1 mm." M. Perrin is evidently not acquainted with Lenard's latest results, MM. Lannelongue, Barthélemy, and Oudin having succeeded in settling a disputed point in pathology by photographing a thigh bone attacked with osteomyelites. The photograph showed that the surface of the bone was intact, while the internal layers are destroyed as far as 1 mm. from the surface. This served to distinguish this disease from periostitis, in which the alterations in the bone proceed inward from the surface to the centre.

Outröntgening Röntgen.

A startling discovery is announced by G. d'Infreville in the *Electrical Engineer* of New York. The process is said to be kept secret for the present for commercial reasons. It is nothing less than a process "for secretly photographing and seeing objects at night or in darkness without the use of the well known flash light." The result is said not to be the same as if the photograph were taken by daylight, some features, entirely invisible by daylight, being revealed by the night light exposure. The seeing in darkness, it is considered, will be a valuable invention for observation of the movements, say, of torpedo boats in time of war, and, no doubt, if it is all the inventor claims, search lights will be superfluous. If the invention can be worn as spectacles, why have artificial light at all. At present this wonderful invention appears not to have completely realised itself in practice, and the announcement, in the meantime, is not likely to affect the price of electric light or gas shares. Even in a dark night it is probable that some light is reflected from objects on a landscape, and a very prolonged exposure may produce an impression on a photographic plate. It probably would take some hours exposure to produce any effect, and, therefore, could be of little value, especially in the case of moving objects.

Resonance.

In our contemporary, the *Electrical World*, Professor Dunstan gives a brief discussion of the conditions for resonance phenomena to occur in a transformer circuit when capacity is present, as well as self-induction, in both primary and secondary. With the usual assumption of constant coefficients, he arrives at some sufficiently interesting results; among them, that with a secondary containing both capacity and self-induction, there are two rates of alternation in the primary which will be synchronous with free vibrations, instead of one only as usual. It would seem probable that the likelihood of dangerous current rushes is not very likely to occur owing to synchronism between the natural period of an inductive circuit containing capacity and the period of the impressed forces. Probably the more likely reason for such rushes lies in the fact that the coefficients of induction are *not* constant. Suppose the primary of the transformer is broken at a value of the current which leaves the magnetism somewhere on an ascending or descending limb of the magnetisation curve. If on making circuit the current should be in the same direction at the instant as it was when the circuit was broken, we will get an enormously different value of the coefficients than we would if it were in the opposite direction, and thus the first wave or so of current might be very much larger than the normal ones. This is a much more likely source of danger than is a cure of resonance, although should the latter occur, the results would certainly be much more serious.

An Interesting Deduction.

During a piece of pure analytical reasoning, Julius Thomsen has recently formulated the hypothesis that there exists a group of inactive elements hitherto unsuspected. The lines of thought by means of which he has reached this conclusion are the following:—If the chemical character of the elements is a periodic function of the atomic weights, such a function must follow the ordinary general laws. In the periodic functions, the change from negative to positive values, or the reverse, can only take place by a passage through zero, or through infinity; in the first case the change being gradual, and in the second case a sudden one. The first case corresponds with the gradual change in electrical character with raising atomic weight in the separate series of the periodic system, and the second case corresponds with the passage from one series to the next. It therefore appears that the passage from one series to the next in the periodic system should take place through an element whose electrical character is $\pm \infty$, and which is, therefore, electrically indifferent. The valency of such an element would be zero, and, therefore, in this respect also it would represent a transitional stage in the passage from the univalent electronegative elements of the seventh to the univalent electropositive elements of the first group. This indicates the possible existence of a group of inactive elements with the atomic weights 4, 20, 36, 84, 132 and 212. The original paper may be consulted in the *Zeitschrift für Anorganische Chem.* 9, 283—288.

MILITARY TELEPHONY.

(With a Single Uninsulated Wire, the P. Charollois System.)

Amongst the resources that modern science places at the disposal of armies in campaign, certainly telegraphy and telephony, notwithstanding their modest position, constitute most important aids to victory in modern warfare.

With their aid, commanders of armies can centralise almost instantaneously all the information required, and thus arrange their forces as advantageously as possible. By their means remarkable precision and rapidity are imparted to military operations. In short, they enable orders to be transmitted in all directions with the precision and promptness of direct commands. The improvements that are continually being introduced into the art of war render its operations more complicated and more delicate every day. Rapidity in the execution of movements has assumed the utmost importance; so much so in fact, that victory is generally due to promptitude in carrying out operations both offensive and defensive.

When two nations are at war with one another, we may say, that to a certain extent, victory remains with the one that effects its mobilisation in the minimum of time, transporting, as far as possible, and with the least possible delay, the greatest number of men supplied with rapid-firing guns, their supplies of provisions being promptly renewed.

Fig. 1.

Fig. 2.

Once out in the open country, beyond large railways and other main roads, the troops are generally scattered over large tracts of country, and are, as a rule, without any regular means of intercommunication. It is here that telegraphy steps in, and also telephony, although the latter has not as yet unquestionably asserted its *raison d'être*, in the first place because it is only of recent date, and secondly, because the apparatus and installations used up to the present have not possessed the qualifications required to give complete satisfaction. By concentrating all his thoughts on the study of this important question, writes M. Pesce in *La Nature*, Captain P. Charollois, of the 115th line regiment, has arrived at a very ingenious solution of it, after long and careful experiments. It was by endeavouring to impart to the telephone, as used for campaigning, all the practical qualities that it lacked, viz., simplicity, lightness, solidity, facility and rapidity of installation, convenience in communication, and to render this very valuable auxiliary easy of manipulation that Captain Charollois was first led to use only a single wire for his telephonic transmissions, using the earth as a return.

This first point is of great importance in itself; but its value is enhanced by the proof of the uselessness of insulation in the wire. In fact, as the result of numerous experiments, Captain Charollois showed that a metallic wire, unwound along the ground, without any precaution as to insulation, had the property of conducting to comparatively great distances—20 kilometres at least—the induced currents circulating between two electric, or even simply magnetic, telephones, placed at the extremities of this single wire, considered as a line, the return being made through the earth.

After many experiments and trials, Captain Charollois has been led at last to use a compound wire of pure copper, with a steel core. This wire possesses all the qualities for the purpose, conductivity, solidity, lightness, flexibility; it does not become oxidised, and is inexpensive.

Captain Charollois has also brought out a microphonic transmitter and receiver, so sensitive, that conversations can be exchanged in the ordinary voice, at a distance, without having to lean over the apparatus, as we generally have to do with ordinary telephones.

To obtain greater precision in communication, and, above all, to render the call bells more distinct, small dry batteries are used, attached to the transmitter, and enclosed with it in a sheet-iron case for protection.

The telephonic post thus formed is carried on the back, and communication is obtained by uncoiling the wires by means of a special spool, the return being effected through the earth by the employment of rods, or even bayonets, buried in the ground, and connected with the post by earth terminals.

Figs. 1 to 6 show the different phases of the establishment of a military telephonic service on the Charollois system with a single naked wire. Fig. 1 shows the soldier provided with an electrical telephonic apparatus fixed on his back by means of straps, like the ordinary knapsacks, and holding in his hand an unwinding spool. Figs. 2 and 3 represent the travelling post at work, with the bayonet buried in the earth for the return circuit. Fig. 4 represents the installation at a fixed station. Fig. 5 shows the transmitting apparatus.

Instead of an electric telephone, and provided that there is no complication, we may use a magnetic telephone, which is still simpler. Captain Charollois has, in fact, conceived and constructed some microphonic receiving transmitters of remarkable simplicity and sensitiveness. The military operator carries the apparatus suspended to his hat, near his ear, in order to listen, and brings it to his mouth in order to speak. For greater convenience two telephones may be used, one for listening and one for speaking, the latter being hung round the neck on a cord.

Organisation of the Regimental Telephone Service.—This organisation comprises two distinct services:—

1. The regimental service, entrusted to the sappers.

2. The company service, entrusted in each company to four soldiers and a corporal appointed by the captain.

The Regimental Service.—The object of the regimental service is to establish telephonic communication between the regiment and the brigade or division, and also for all operations requiring lines of great length. On fields for shooting practice, these movable telephone lines are also used, and they are of the greatest service in artillery practice and regu-

lation shooting. These lines, which consist of wires $\frac{6}{10}$ of a millimetre in diameter, may be 20 kilometres in length, and must often remain in position for several days without being taken up. They have, therefore, to be laid with a certain amount of care; the apparatus required is as follows:—

Regimental Apparatus.—Six unwinding reels, 6 kilometres of wire; six magnetic telephones, three hooked

Fig. 3.

bamboo rods, four earth terminals, four hooks for suspending the telephone. The weight of the reel, when wound with 1 kilometre of wire, is 3·500 kg.

The Company Service.—The object of this service is to enable the company to establish, under any circumstances of the campaign on the field of operations, one or more telephone lines capable of attaining a total length of 4 kilometres. The principal cases in which they are used are as

Fig. 4.

follows:—To connect the main body with the sentries and with the outpost reserves; to transmit to the main body the information gathered by the patrol; for use in the cantonments; the connection of detached services over irregular ground, mountainous or wooded districts, &c. The judging of distances in shooting practice.

As these company lines are always established on peaceful territory, there is no need to suspend the wire, and it is simply unwound along the ground. The company apparatus has, therefore, been reduced to the simplest possible form by using wire $\frac{4}{10}$ of a millimetre in diameter wound on a spool of small dimensions, and suppressing the bamboo rods.

Company Apparatus.—Two unwinding reels, 4 kilometres of wire (2 kilometres per reel), four magnetic telephones, three earth terminals, three telephone suspension hooks. The weight of the complete reel wound with 2 kilometres of wire is 2·500 kg.

Establishment of a Regimental Line (fig. 6).—Suppose that a line of 6 kilometres is to be established: the corporal, or a supplementary operator, takes up his position at the point, A, placing his telephone to his ear, connecting it by one of his conductors with the line, and by the other with his bayonet stuck in damp soil. The first set of men begin to

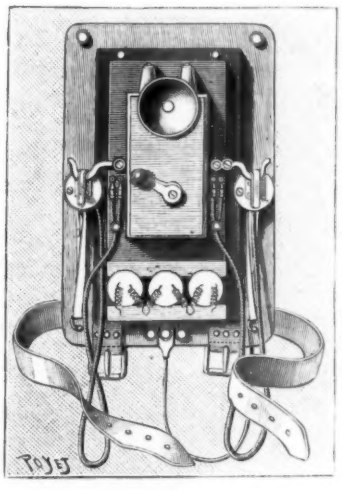


Fig. 5.

unwind the wire. To do this, the bearer of the reel (fig. 1) marches in the direction, B (fig. 6), at quick march, without troubling about the wire he leaves behind him. He takes care to march towards the supports to which the wire is to be hooked or suspended.

His comrade, who is provided with the hooked rod, follows him, and hooks the wire to the natural supports that he finds on the way, trees, houses, hedges, &c. In default of natural supports, the wire is allowed to lie along the ground, preferably in furrows, trenches, &c. The line, whether sus-

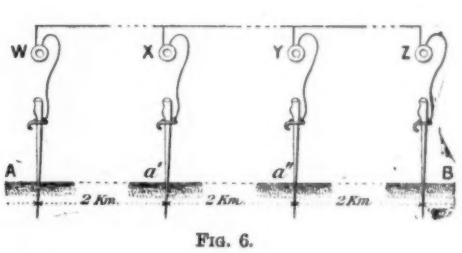


Fig. 6.

pended or lying on the ground, must be protected from any conditions likely to cause its breakage.

The first set of men having unwound their 2,000 metres, the bearer of the telephone takes up his position at a', an intermediate post, as has already been done at point A, and at once enters into telephonic communication with his comrade at the head of the line. When the bearer of the rod for the first set has finished his work he holds himself in readiness to inspect the line, so as to find out and repair any accidental breakage that may have occurred, and that would be indicated by the cessation of communication. Thus these two men have the charge and superintendence of the portion of the line that they have laid down; they become, so to speak, its guards.

The second messenger, having attached his wire to the line, proceeds, as has already been explained, for the first. This operation is continued as far as B. The line of 6 kilometres will comprise four telephonic stations; two terminal ones at the ends of the line, A and B, and two intermediate, a' and a'', for the inspection of the line. All these stations are in communication with one another.

This arrangement of the military line explains how unceasing surveillance can be exercised, how accidental breakages can be repaired, and, lastly, how it was that a line of 25 kilometres was able to be taken up in one hour during the Eastern manœuvres. The order having been given to all the stations at the same moment to take up the line, each set took up the line that they had laid down.

Of course, when the country is quiet, the line well laid, and there is no reason to fear any accident, the intermediate stations may be suppressed, and the sound can then be heard all the better at the two extreme stations. With the object of ensuring the greatest freedom of movement to regimental telephone operators, these men, during manœuvres, and when on a campaign, receive the allowance granted to isolated members of the regiment, in order that they may be able to live in any part where they may be detained by their special duties. This measure was adopted during the Eastern manœuvres.

Establishment of a Company Line.—This operation does not need all the precautions that have to be taken for the protection of a regimental line. It consists merely in unwinding the wire along the ground, following, however, all the ditches, furrows, or hollows, so that the line shall be as far as possible protected from breakage. The connections between the lines and to earth are made as above described.

Communications with operators on the march.—In certain operations, such as reconnoitring, patrolling, exploring, &c., it is important for the main body to have constant communication with the detachment sent out. In this case the operator, with his left hand, keeps the sword bayonet connected with the telephone at his ear. The current is then permanently established, even during the march, through the body of the operator, and his feet which tread the soil. Every call from the main body is distinctly heard by the telephone operator or horse soldier, who stops and replies. Under these conditions the commander of the main body has always these detachments under control, and can send them at any moment his orders and instructions. The operator or horseman, being thus in communication through his body, should walk as much as possible on the earth, or on grass, in order that his feet, or his horse's, should have good contact with the earth.

Employment by Cavalry.—This telephonic system can be of great service to cavalry regiments for the rapid conveyance of information gathered by reconnoitring parties and sentries. The modes of communication are the same as for the infantry. Nevertheless the horseman can, as described above for the foot soldier, be in constant communication, even when on the march, with head-quarters. His telephone, which is at his ear, is in direct communication with the line by one of its conductors. The other conductor is connected with the bit, and consequently to earth through the body and shoes of the horse. If it should be necessary to establish a telephone line very quickly, the wire might be unwound by a cyclist. Extending the application of his naked wire system of telephony to every-day uses, Captain Charollois has also constructed a series of instruments meeting ordinary requirements, and forming altogether a system of civil telephony that can be utilised in various ways.

Electro-magnets for Lifting Purposes.

ELECTRO-MAGNETS FOR LIFTING PURPOSES.

The following particulars and photographs of some electro-magnetic lifting devices, which have been in everyday use at the Proof Butts, Royal Arsenal, Woolwich, for the last four years, are published by permission of the Inspector-General of Ordnance.

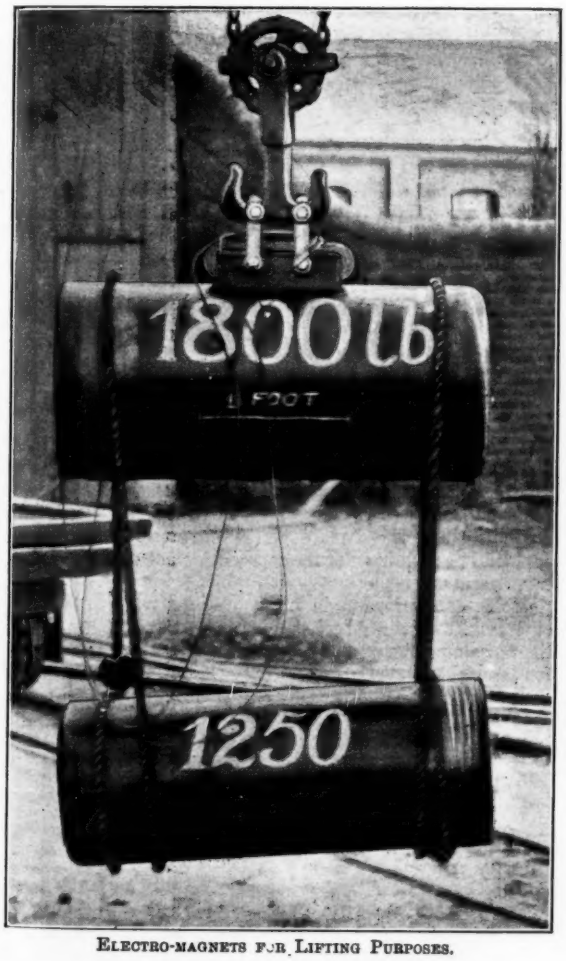
The magnets in question were designed by Major H. C. L. Holden, R.A., F.R.S., for the special purpose of lifting the shot that are used for proving guns and for ballistic experiments generally. These shot, it will be seen from the photographs, are of special form, having a flat instead of a pointed head in order that their motion may be arrested as quickly as possible in the sand of the butt into which they are fired. The shot weigh from 1,800 lbs., the weight of the projectile fired from the 110-ton gun, downwards to the smallest bores; they are piled one upon another in the stores, and it used to be somewhat laborious work moving them when required, not only on account of their weight, but also on account of the difficulty of getting slings round them. The introduction of the electro-magnet in the place of the slings has made the task easy, and one which is, moreover, quickly performed. The figures require but little explanation, as they show clearly the construction and method of employment.

The body or core of the magnet is ∩-shaped and in one forging. The winding is mechanically protected by stout brass flanges and is covered with thick brass strip. The ends of the winding are led to duplicate terminals. Duplicate twin wires, to prevent accidents in the case of the wire fouling and breaking, being taken over pulleys to the switch box on the counter-weight at the back of the crane.

A single-pole switch is placed in this box and is used, in conjunction with a water resistance, to shunt the extra current produced on breaking the circuit, to close or open the circuit. The current varies from 3 to 4 amperes at 20 to 30 volts, the maximum weight that can be lifted has not been ascertained exactly, but it exceeds 3,600 lbs., as two 1,800 lbs. shot can be lifted, one slung below the other, in the manner shown in the photograph of an 1,800 lbs. and 1,250 lbs. shot being thus lifted. The shot are of hard cast-iron or cast steel, their surface is rough and thickly covered with paint. The weight of the electro-magnet complete is about 45 lbs.

DISINTEGRATION OF ORGANIC TISSUE BY HIGH TENSION DISCHARGES.

The cases in which electricity has been applied successfully to the treatment and cure of disease, are by no means so numerous as we should expect. Among the many applications that have been attempted in this direction, few seem more promising than the destruction of malignant tumours by the electric discharge, so as to dispense altogether with the use of the surgeon's knife. This end does not appear yet to have been attained, but the series of interesting experiments on this subject recently made by Dr. J. Inglis Parsons* shows that considerable progress has been made in this direction. Dr. Parsons's opinion, after several years experience, is "that the rôle of electricity as a method of



Electro-magnets for Lifting Purposes.

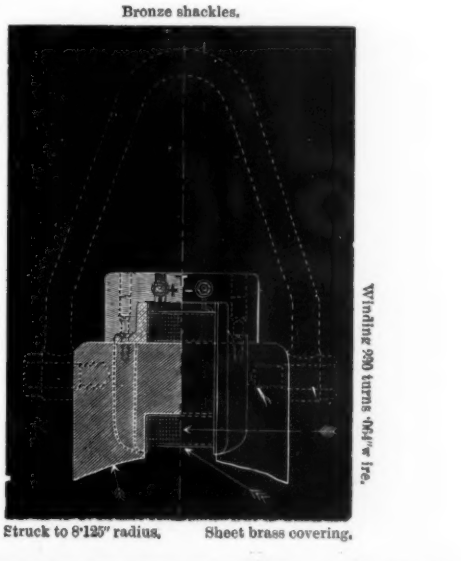
treatment, except for small ulcers, is to follow after excision when nothing more can be done by the knife, and recurrence has occurred."

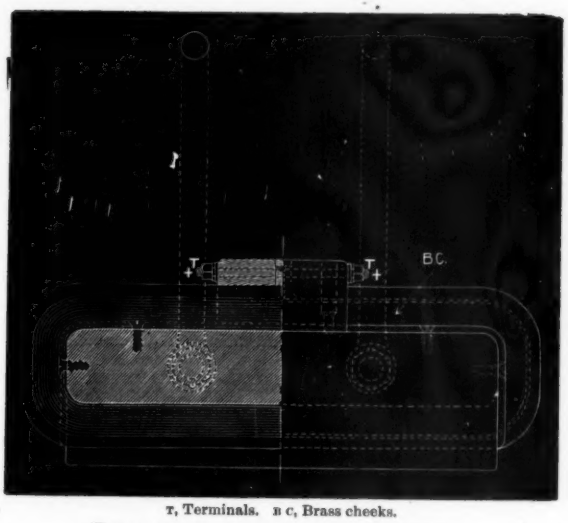
The important discovery which Dr. Parsons describes in this paper is that organic tissue can be disintegrated throughout the path of a current without appreciable heat or caustic action by the use of discharges from an induction coil. In 1888 he found that the effect of a constant current applied to fibroid tumours was confined to a small area around the poles, and that the destruction within that area was greater than was necessary. It appeared to him, therefore, more hopeful to endeavour to utilise the disruptive effect of a sudden discharge, and with this view the effect was tried of suddenly applying the current of a powerful voltaic battery. The success was only partial, and his experience thus far led him to think that the discharge from a powerful induction coil, with the lowest possible resistance in the secondary coil, would probably be the most effective for his purpose.

* *Trans.* Obstetrical Soc. of Lond., V. 37.

The coil used in these experiments was made with the break to be worked by hand, and with a resistance in the secondary of only one-seventh that of the ordinary coil giving the same spark length. Dr. Parsons's object in reducing the resistance of the secondary coil from 7,000 ohms to 1,000 ohms was to concentrate in the tumour a larger proportion of the total electric energy developed in the secondary circuit. The resistance of a tumour being from 100 to 250 ohms, very little of the total energy developed in a secondary circuit of 7,000 ohms would be developed in the tissue.

Dr. Parsons's experiments were made by inserting platinum electrodes into pieces of beef, sections of which were examined under the microscope before and after the discharge from the





T, Terminals. B C, Brass cheeks.

Electro-magnets for Lifting Purposes.

coil. These sections showed that stripped muscular fibre could be completely disintegrated throughout an ellipsoidal space between the two poles. It was observed that the destruction was not quite so complete in the axis of the ellipsoid as nearer the surface. This curious effect, we should think, is due to the well-known tendency of rapidly varying currents to fly to the circumference of conductors. Another interesting outcome of these experiments was that within certain limits the effects of successive discharges were cumulative; if a discharge were too weak to produce disintegration with one application, success followed repeated applications of the same discharge.

Dr. Parsons thinks that pressure is of more importance than current in obtaining these disintegration effects. In that case, it is difficult to see why the reduction of the resistance of the secondary coil should be advantageous. It is difficult from the meagre data given in Dr. Parsons's paper

to determine the exact electrical conditions to which the organic tissue was subjected. A reduction of the resistance of the secondary coil would retard the rise of the current in it, and consequently would not subject the organic tissue to so great a difference of potential as a secondary of higher resistance. An experiment made by Dr. Parsons with a Leyden jar in circuit seems to support this view; here the increase of current was still more rapid, and the disintegration was found to be excessive, though it was confined almost completely to the line joining the poles. We congratulate Dr. Parsons on the success of his experiments, though we consider that more precise measurements are necessary to determine the exact electrical conditions as to current and pressure which are best adapted to produce the most favourable results.

THE SIEMENS PROCESS FOR RECOVERING GOLD FROM ITS CYANIDE SOLUTIONS.

The *Financial News*, in the issue dated 6th inst., has published the following paragraph which might mislead readers:—

The *Johannesburg Star* concludes an interesting article on the George Goch Amalgamated property as follows:—"Another alteration at the Metropolitan is the substitution of the zinc process (MacArthur-Forrest) in the place of the Siemens-Halske in the cyanide works. This was only done after the most careful experiment, and, last month—the first month during which the zinc process was at work—an actual extraction of 70 per cent. was obtained. Considering that this was the first month, and that the zinc and the solutions both retain a portion of the gold, the extraction is a very satisfactory one indeed, especially when compared with the 55 per cent. of the Siemens-Halske. Had the latter been proved the best it would have undoubtedly been adopted at the George Goch; but, under the circumstances, Mr. Way had no option but to take the process which gave the best results. A stock of old sour tailings, worth 3 dwt. 8 gr., are now being treated successfully, and these the manager of the cyanide works, before zinc boxes were put in, refused to treat on account of their condition. Last month 4,000 tons were treated, and a profit of £1,000 made out of these old tailings, and the profits will be greater when the zinc and the solutions have been in use two or three months."

For 18 months we have had many statements and reports emanating from reliable and competent men which all tell us that the electro-deposition process worked by Messrs. Siemens in the Rand is a success, and is much superior to the zinc process. We cannot believe that the yield by the Siemens process is only 55 per cent. while with the zinc process it is 70 per cent. Even with a good electrolytic system there is not much margin between success and failure when the man who works it is not the right one and does not understand his business, or when he is biassed this may be the case.

There must be a mistake somewhere, and we are sure that electrolysis, if properly applied, ought to extract more than 70 per cent. from a gold cyanide solution.

The writer of the *Johannesburg Star* does not appear to us to know what he is talking about, as he says that considering that this was the first month and that the zinc and the solution both retain a portion of the gold, the extraction is a very satisfactory one indeed. If the solution retains a portion of gold, how can the extraction be considered as very satisfactory?

PHOTOGRAPHING THE UNSEEN.

We abstract from two of our Parisian contemporaries the following details, which serve to explain the apparatus used in effecting the new photographic operations by means of the Röntgen rays:—

Prof. E. Hospitalier, writing in *La Nature*, says that the first experiments tried in France were performed at M. Le Roux's laboratory at the Higher School of Pharmacy, by M. G. Seguy, and subsequently repeated by Drs. Oudin and Barthélemy, Lannelongue, &c. Prof. Hospitalier shows a reproduction, on a reduced scale, of the radiographic representation of a gold watch with a silver chain, taken specially for *La Nature* by M. Seguy, by the aid of the experimental apparatus shown in fig. 1. A battery of six bichromate of potash elements, P, works a Ruhmkorff coil, T, the secondary wire of which can give a spark of about 10 centimetres. The secondary wire of this coil is connected with a Crookes's tube, B, from which the air has been exhausted to 1 millionth of atmosphere (1 milligramme per square centimetre). M. Seguy utilised a ball, the anode of which bears a star of eight points. This apparatus enabled him to demonstrate the reflection of the cathodic rays; but the star is useless for radiographic experiments. The chain and the watch are placed in a wooden box, F, behind which is fixed the gelatino-bromide sensitive plate, wrapped in a sheet of black paper. There is a distance of about 12 centimetres between the Crookes tube and the sensitive plate. A board, 1 centimetre thick, gave, after 35 minutes, a very clear but very

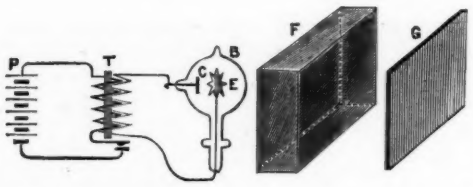


Fig. 1.—Diagram of the Arrangement adopted by M. Seguy for the Repetition of M. Röntgen's Experiments. In Practice, F and G are Superposed.

faint proof. By substituting for the board a sheet of aluminium, half a millimetre thick, and allowing the same time, a very decided impression was obtained.

By these various examples we can see how easily M. Röntgen's experiments might be repeated and varied infinitely. We can already foresee a great number of applications for these radiographic pictures for medical and surgical purposes in particular; but this is a domain into which our absolute incompetence forbids us to enter, and we therefore leave this part of the subject to be dealt with by other writers, it being our object merely to place before our readers the general explanations required for the reproduction of these interesting experiments.

Mons. Albert Nodon, in *L'Electricien*, gives the description of an experiment at the Laboratory for Physical Research at the Sorbonne (fig. 2). We are indebted to our contemporary for the block.

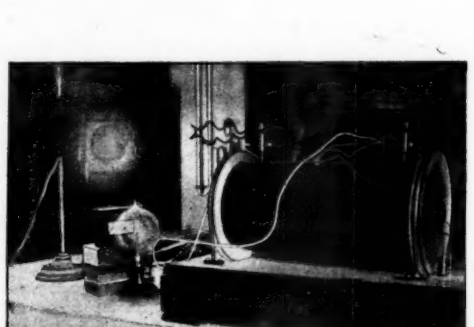


Fig. 2.—Arrangement used at the Laboratory of Physical Research of the Sorbonne for the Study of the Röntgen Rays.

An induction coil was acted upon by a current with a mean intensity of 2 amperes. The two poles were put in communication with a Crookes tube, 8 cm. in diameter.*

This Crookes tube, the internal pressure of which barely amounted to a few microns, enclosed a central electrode formed of a thick aluminium wire surmounted by a star of the same metal.

* This tube had been offered to M. Jamin, Director of the Laboratory for Physical Research at the Sorbonne, by Mr. Crookes himself.

The second electrode was arranged to follow the same horizontal diameter, and consisted of an aluminium disc of about 2 centimetres in diameter.

The sensitive plate treated with gelatino-bromide of silver was enclosed in a negative frame, and placed 6 or 8 centimetres from the Crookes tube, according to the diameter passing through the two electrodes.

The opaque object to be photographed by means of the cathodic rays was arranged between the Crookes tube and the frame.*

The induction coil was then acted upon, the tube became illuminated with a faint greenish light produced by the fluorescence of the glass, and the shadow of the central star of aluminium had just detached itself on the inside of the globe.

The nature of the poles did not seem to have a very marked influence on the phenomena; these seem, however, to have been more marked when the disc was put into communication with the negative pole of the armature.

When the experiment had lasted some minutes, the star and the aluminium wire were heated to the temperature of red heat, and at last the star finished by becoming fused, and became completely detached. The tube, however, remained no less capable of producing the cathodic phenomena.

[In previous column, line 6, read "globe" for "ball."]

THE TELEPHONE QUESTION.†

By ALFRED R. BENNETT, M.I.E.E.

Several important facts connected with the telephone question have recently been presented in a manner which advocates of the existing state of matters in the United Kingdom have not seen their way to challenge.

These facts may be briefly summarised as follows:—

Firstly, that in the great majority of foreign countries the rates of subscription paid by telephone subscribers are notably lower than those exacted in the United Kingdom.

Thirdly, that the difference in the charges between Continental countries and the United Kingdom is not caused by cheapness of labour, or cheapness of materials abroad.

Fourthly, that the greatest degrees of development are attained by means of local enterprise.

Fifthly, that the telephone is put to more numerous uses abroad than it is in the United Kingdom.

Sixthly, that municipal enterprise has been successfully applied to the management of telephone exchanges.

Seventhly, that competition between two telephone companies within the same area has a stimulating effect on the growth of telephonic work, while it is not inimical to good service.

It would be superfluous to repeat here proofs which have been given of the truth of the foregoing statements as each and all of them have been severally examined and discussed publicly during the last six months. I shall, therefore, ask you to accept them as true. The question then arises, why cannot the circumstances which have led to such good results abroad be repeated at home?

The answer is furnished, firstly, by the existence in the hands of one company of a complete monopoly of the telephone exchange business in the United Kingdom, with the exception of a few insignificant exchanges owned by the Post Office. Secondly, by the policy of the Post Office, which is to support the monopoly possessed by that company.

While advocating in the House of Commons the conclusion of the agreement between the Post Office and the National Telephone Company, the two last Postmasters-General deprecated the idea of investing any company with a monopoly, and reserved the right of the Post Office to grant new competing licenses if necessary, so that the public would always possess a remedy against bad service or high rates; and on these assurances the agreement was allowed to be passed.

Relying on the reiterated statement in the House that the Post Office had reserved the right to grant additional licenses, the Corporation of Glasgow, in which town the service given by the National Telephone Company had come to be regarded as unsatisfactory, applied for a license to erect and work a telephone exchange of its own. Without opposing a direct negative to the application, the Postmaster-General refused it in effect by prevaricating about his promise to grant additional licenses, and by seeking to give that undertaking a different interpretation to the meaning which it bore in plain English, and to the meaning which had without suspicion been assigned to it by those members of Parliament who were anxious for telephonic reform. When the granting of a license continued to be urged the Postmaster-General spoke of the evils which he was advised would result from the existence of two separate exchanges in the same district or town, although experience in competition, which has not been wanting even in the United Kingdom, failed to bear out his assertions that it was detrimental to the public interests. He said that the Post Office itself had reserved the right to compete in any town or district in which the service was (according to the Post Office and not to the public) unsatisfactory. But such possible Post Office competition is nothing better than a mere pretext intended to allow the existing position of things to continue, as the Post Office charges for telephone exchange communication are considerably higher than those of the National Telephone Company itself, so that Post Office competition affords no sort of remedy to those who consider the company's charges excessive. Besides, the Post office has demonstrated its inability to compete with the National Telephone Company. The offer of Post Office competition, therefore, as a remedy in places where dissatisfaction exists with the Company's service is but a sorry jest.

Before the Select Committee the National Telephone Company professed to be convinced that competition was no longer possible, because its license will expire in 1911, and it is assumed that any fresh licenses which may be issued would be made terminable at the same time. The resulting tenure would be so brief that Mr. Forbes said that it would be absolutely impossible for any company or municipality proposing to compete with it to raise the necessary capital. Such seasonably sceptical views are not uncommon on the part of chairmen of companies threatened with opposition. For instance, Sir Edward Watkin predicted that the Manchester Ship Canal would never be made, and that for a very simple reason, namely, that the necessary capital would never be raised.

Events have shown that Sir Edward Watkin was wrong, and Mr. Forbes's views were not shared by the witnesses who appeared for the Glasgow Corporation.

No doubt, if a company proposed to raise capital the task would be a difficult one, but if a competing company erected a really good system the Post Office would be practically compelled to purchase it for at least its actual cost in the event of the license being recalled after 16 years. Then a Common Good fund exists in Glasgow which could be used for the purpose of constructing an exchange; and abroad the rates are used for the purpose in places where municipal exchanges exist, with results beneficial to the ratepayers, inasmuch as good profits are always earned. But a company might not be able to raise capital; the right of the Glasgow Corporation to use its Common Good fund might be challenged, and the Town Council might not obtain the necessary permission to use the rates. How then could the necessary capital for competition be obtained? Very easily, and in a manner which that best of all tests, experience, has shown to be perfectly successful.

In several foreign countries the capital has been raised by inviting those who desire to enjoy the benefits of telephonic communication to pay an amount down, this payment being apart from, and supplementary to, the ordinary annual subscription, which is payable in advance. Continental experience shows conclusively that telephone exchange lines with their necessary instruments do not cost more to construct than £10 or £12 each, even in such a large city as Christiania, and even when the cost of trunk lines connecting with neighbouring towns is included. Assume the case of a company or municipality wishing to construct an exchange on this system, each man would bring the cost of his line with him, and there would be no occasion to go to the public for capital, or, in the case of a town council, to borrow or to call upon the ratepayers for any advance. It may be said that when this is done the company will have to provide for the first year's working expenses before the second annual subscription becomes due. If the amounts paid down by the subscribers in advance are not sufficient to cover this item, which, in the case of a new exchange is a very insignificant one, the company could borrow money on the plant already erected, and so make good any deficiency, the borrowed money being made a first charge on the profits.

A metallic circuit exchange comprising the latest improvements could be constructed in Edinburgh and district, at a cost of £16 per line, and such an exchange would be worked at a profit on a subscription of £5 10s. per annum. The original payment by intending subscribers would be £5 10s. + £10 10s. = £16.

If we had to deal with towns of the largest size, such as Glasgow, Liverpool, or Manchester, the cost of the lines would be about £17, and the annual subscription necessary to work at a profit would be £5 15s. The subscribers original payment in this case would have to be £11 5s. + £5 15s. = £17.

It may be said that to call upon the subscribers to pay such an amount down as (in the case of Edinburgh) £16, would be to make too large a demand on their pockets; but when it is considered that the ordinary subscriber now pays the existing company £10 per annum in advance, whereas by the proposed plan he would pay £16 once, and only £5 10s. per annum for all time thereafter, it will be seen that this objection is not a very weighty one. In four years he would pay only £32 10s. instead of £40 as at present, and in five years £38 instead of £50. With such a system the possible recall of the license in 16 years possesses no importance; it would pay if the license lasted only three or four years. In that time the subscribers would have saved money on their annual payments, apart from the value of the exchange, which would, nevertheless, remain their property. Besides, a subscription of £5 10s. in Edinburgh would yield a handsome profit annually, even after paying the Post Office royalty, so that a company would have funds on its hands to dispose of in some shape or form. If shares were accepted in return for the contribution, each subscriber would be a shareholder too, and would enjoy an annual dividend. Or, as is done by some of the Swedish, Norwegian and Danish companies, the profit could be used for the purpose of reducing the amounts of the subscriptions instead of being paid away as ordinary dividends. It must not for an instant be assumed that an exchange provided in this way need be of the cheap and nasty order. By no means; metallic circuits for the lines, the most modern apparatus for the instruments, and all appliances of the best sort, could be provided for the sum named.

Advocates of the existing state of things will probably say that such a scheme is impracticable, and that people will not pay money down. The answer to that is that it is done in many places

D

* Behind the frame, we see on fig. 2 an incandescence lamp, which is not part of the installation described above.

† Abstract of paper read before the East of Scotland Engineering Association at Edinburgh, February 5th, 1896.

abroad, and what foreigners perceive to be a reasonable arrangement will not fail to recommend itself to the inhabitants of the United Kingdom. The General Telephone Company of Stockholm, which possesses more than 10,000 subscribers in the city of Stockholm and its immediate suburbs alone, is, and has always been, conducted on this plan. If 10,000 persons in Stockholm have been able to pay money down in the shape proposed, there cannot be anything very serious to urge against its feasibility. The plan besides being practised in Sweden, Norway, and Denmark, has been very successful in the Grand Duchy of Finland, the telephonic exploitation of which is in the hands of companies and co-operative societies. The Governments of Austria and Roumania require their subscribers to find the capital for the construction of their lines; the French Government does the same except in Paris and Lyons, and the Luxemburg Government also brings the plan into use in certain specific cases. It is likewise well known that companies in the United States have built telephone exchanges and constructed trunk lines with no other capital than that afforded by the payment in advance of the bare subscriptions for one year. Besides, should the payment of the contribution in one sum be objected to in some cases it would assuredly be possible to arrange to spread it over three or five years, as is done in Austria and some other countries. We may be sure, therefore, that it is quite practicable if only the Post Office could be got to permit it, to start competing exchanges in the United Kingdom, or at least to establish exchanges in some of the very numerous towns and districts which are at present totally unprovided with telephonic communication without calling upon the general public to contribute any capital, without using the money of the ratepayers, and without drawing upon Common Good funds.

It is interesting to note that the opinions in favour of monopoly, and especially in favour of the monopoly of the National Telephone Company, which are entertained by the permanent Post Office officials who appeared before the late Select Committee, and by whose influence the opinions of Postmasters-General are shaped, are not shared by all the Post Office authorities. It was admitted before the late Select Committee that the late Mr. Fawcett was absolutely in favour of free competition in telephones. The late Mr. Raikes was likewise opposed to amalgamation taking place between the different licensed companies, as he looked upon monopoly as inimical not only to the interests of the public, but to those of the Post Office also. The two gentlemen named were Postmasters General, but their views are shared by members of the permanent staff. Mr. F. E. Baines, C.B., late Inspector-General of Her Majesty's mails, served 40 years in the Post Office as an official, and during many years was the effective controller of the Post Office Telegraphs. Mr. Baines, as is evidenced in his book "Forty Years at the Post Office," and "On the Track of the Mail Coach," takes an infinite pride in the achievements of the Post Office, and such a man would be the last to favour free telephonic competition, unless his experience convinced him that it is the only method calculated to fully develop the telephonic needs of the nation.

The extracts from Mr. Baines's last book, which form an appendix to this paper, leave no doubt that the present advocacy of monopoly within the Post Office is more an accident of individuals than of settled departmental conviction. It will be noted that Mr. Baines is satisfied that a £5 subscription is sufficient for local requirements, and that his estimates of the cost of erection and maintenance of telephone lines do not agree with those put forward by the Post Office witnesses before the late Select Committee, but are more consonant with the experience obtained by the Mutual Telephone Company, the Christiania Telephone Company, and other independent concerns. Major-General Webber, C.B., another Post Office engineer of long experience to whom the construction of some of the chief routes of telegraphs in the country is due, is also totally opposed to the aims and estimates of the present officials.

Some of the evidence which was given before the late Select Committee calls for special consideration at the hands of municipalities and of telephone users. Mr. Forbes, speaking for the National Telephone Company, said that in about 9 years time the tenure remaining to the company will have become so short that it will no longer pay the company to invest capital in the further development of its system. This means, therefore, that if the Post Office and the National Telephone Company are allowed their own way, no person or firm will be permitted to join a telephone exchange after the year 1901, because, as the company's license expires in 1911, it would not be profitable to construct any more lines. Surely this threatened stoppage in development is a matter which ought to be taken into serious consideration by municipalities. Possibly it is a threat on the part of the company, intended to force an extension of its license from the Post Office, but such an alternative is almost as grave as the former one, and the existence of the threat makes the date of the final telephonic crisis 1904 instead of 1911, and a correspondingly earlier solution is consequently called for.

The want of agreement between partners is generally accepted as a proof of the weakness of their case. In this connection it is noteworthy that the evidence given by the Post Office, and by the National Telephone Company, before the late Select Committee, did not always agree, and sometimes, even on essential points, was contradictory. The Post Office witnesses, in order to support their exaggerated estimates and to justify the high charges of the department, laboured to convince the Committee that as telephone exchanges grow, complications of the wires and switching apparatus increase out of all proportion to the additional number of subscribers, and that the cost of the switching apparatus especially increases in a ratio, which, if it were true, would justify Mr. Arnold Morley's statement that the telephone can never be more than a luxury for the rich, since the growth of the exchange would soon render the cost of its extension prohibitive. If the Committee had heard independent witnesses, it would have been demonstrated that the Post Office figures are not justified by experience, which shows that the ratio of increase of cost in a properly laid out exchange is not notably out of proportion to the increase of subscribers' rentals. Mr. Forbes, speaking for the National Telephone Company, practically demolished this part of the Post Office evidence, as he told the Committee, in explaining why the rate in Lancashire, which was originally £20 per annum, had been reduced, said that while the exchanges at Manchester, Warrington, Liverpool, &c., were in their infancy it was necessary to have a high rate, but that they grew rapidly and to such an extent that the directors saw their way to make a reduction to £15 per annum, and, subsequently, after a further increase in the number of subscribers to £10. According to the Post Office evidence rates under such circumstances ought to have increased, whereas the company adopted precisely the opposite plan and reduced them by 50 per cent.

Before the same committee the National Company deprecated competition as inimical to the interests of subscribers and the public generally, but then its preaching on this occasion differed widely from what has been its practice. For instance, Messrs. Tasker and Company established their exchange in Sheffield, and held the town for many years without a rival, but in 1887, when Tasker's exchange was already a large one, the National Telephone Company commenced business in Sheffield, cut down rates to £5 for any distance, and, notwithstanding its professions of solicitude for the public interest, deliberately inaugurated competition of the most active kind within the same area. That competition ultimately resulted in the acquisition of Tasker's exchange by the National Telephone Company, but Tasker, in giving up his business, made stipulations which have secured to the Sheffield public rates from that company (see my paper on "Municipal Telephony," read before the Northern Society of Electrical Engineers, November 11th, 1895), which are lower than those enjoyed by any other town of corresponding importance. The Post Office opened an exchange in Cumberland; some months later the National Telephone Company commenced a competing system, and ultimately blotted out that of the Post Office. In Leicester, the Post Office opened an exchange and connected to it nearly 200 subscribers; years afterwards the National Telephone Company commenced competition in Leicester at lower rates, and has now so reduced the Post Office exchange that only a remnant of some 20 subscribers is left to it. Other instances could be adduced in which the National Company has been the aggressor, and it would be interesting to learn how this fact can be reconciled with its present objection to competition. Is it not probable that this solicitude for the public interest has its origin in the fact that, owing to the existence of its present monopoly, the National Telephone Company must necessarily in the future, be the attacked and not the attacker?

APPENDIX.

Opinions on the Telephone Question Expressed by Mr. F. E. Baines, C.B.* Extracted from his recent book "On the Track of the Mail Coach." (Bentley & Co.)

The telephone, which I regret to see a statesman of weight regards as a luxury of the rich, is, from my point of view, a necessity of the poor. The public have little idea of its enormous social and commercial importance to all classes.

Not in my opinion alone, but in that of persons who can speak authoritatively on the subject, is a telephonic exchange needed in every town and in every considerable village.

A telephone made without the middleman costs but a few shillings; it need be no more expensive than a Waterbury watch.

The annual cost of keeping up a mile of telephone wire ranges at the most from 25 to 45s., and even allowing for the doubling of the wire, £3 would probably be an outside average. Perhaps even £2 a year per wire would, in practice, cover everything.

The prime necessity of a liberal extension of the telephone in the direction indicated, I mention here, not as an original suggestion of my own. . . . It has been urged in a general way more than once by a member of Parliament who has for some years past directed public attention to details of postal economy, and it has been advocated in the public press, and before a Select Committee of the House of Commons.

There would seem to be a general consensus of opinion that a liberal use of the telephone in rural districts would be of immense advantage to the State. How the telephone should be provided, by whom and under what conditions, may be matter of opinion, and is, in any case, of secondary importance. The primary object should be, by hook or by crook, to bring the telephone within reach of everyone.

But no insuperable difficulty occurs to me, in the working out of such a scheme as is presented in this chapter, by the Post Office in conjunction with any telephone company. A company would contract for, supply, and maintain telephone lines either on its own responsibility or as the agent of the department; and to the advantage of both.

Where the annual charge would be less than £5, purely local communications are in view; where it would possibly be more than £5, communication through two exchanges is contemplated.

In other words, telephonic communication from one part of a village to another part of it, or, similarly, from one part of a country town to another part of the same town, can be very cheaply provided and maintained. When a renter in the village requires the means of telephoning to a renter in a neighbouring town, and two exchanges are put in action, the cost is necessarily somewhat enhanced.

In time, rich and populous England will learn a useful lesson from small and thinly-inhabited states—from Sweden and from Switzer-

* Late Her Majesty's Inspector General of Mails, and formerly Chief Controller of the Post Office Telegraphs; author of "Forty years at the Post Office." Mr. Baines was first to formulate proposals for the acquisition of the telegraphs by the State.

land, from Denmark and elsewhere; for already in Sweden the Government is about to combine the telephone with the State telegraph system. In that country everybody is stated to be "on the telephone." This is the key of the whole situation.

England, whether urban or rural, would be a changed place—half its troubles would vanish—if that development were given to the telephone, of which it is capable.

THE BLOT ACCUMULATOR.

It may be reasonably expected that there will be placed on the English market very soon an accumulator which will merit careful consideration. It is one which has been invented by Mr. G. R. Blot, and though known to few in this country, is fairly well known in France. The plate which is used in this cell is made on the well-known Planté principle, but it has achieved such excellent results in the laboratories of Mr. Preece and M. D'Arsonval, that the modifications introduced by Mr. Blot require some detailed explanation. It should also be mentioned that its reputation does not depend entirely on laboratory tests, for it has been used in actual work for a considerable period, and judging from the remarks of the users—who, not being electrical engineers, are unable to bestow upon them skilled attention—the cells seem to have given great satisfaction, in spite of the fact that they are called upon to work at rates of discharge much above the normal. We have recently expended considerable energy in endeavouring to demonstrate that durability is of vital importance—nay, is almost the determining factor—in one's estimation of a cell. How far the Blot accumulator will fit in with this desideratum remains to be seen, though in fairness it should be stated that trials extending to two years have been made on the plates with what are stated to be excellent results. The capacity per unit of weight, and the high rates of discharge of the Blot accumulator, are especially noteworthy, and these features, combined with the mechanical construction of the plate, ought to make the cell of special interest at the present moment. We would remark at the outset that we have not made any personal tests whatever on the Blot accumulator. Mr. Blot has allowed us to inspect correspondence and reports, and we have had an opportunity of examining the plate, but the figures that are mentioned in this article are entirely quoted from experiments made by others.

The plate is composed of a series of flat coils round the core, *a*, *a*, of which are wound, as shown in fig. 1, two lead ribbons, D and C, ½ millimetre in thickness, one, D, being corrugated and embossed, the other, C, being corrugated only. The cores of the coils are of non-plastic metal, and are soldered to the frame, which also consists of lead not liable to be attacked (fig. 2). This ingenious arrangement gives a large active surface with a small amount of lead (·333 m² per kg. of plate), as well as great porosity, due, we presume, to the layers of the ribbon being kept apart by the corrugations.

The coils of all sizes, which are formed as shown in fig. 2, are sometimes cut into two equal parts along the straight line, *a*, *b*, and each part forms the coil. Fig. 3 shows the mounting of a plate composed of four coils, which constitute the ordinary type of plate; figs. 4 and 4A shows the smaller type. The solderings, S, fig. 3, of non-plastic metal keep the core of the coils on the frame, M, N, O, P; these solderings, which are also of unoxidisable metal, ensure the electrical conductivity of all the leaden ribbons. It is claimed that these solderings of unoxidisable metal do not undergo any alteration after prolonged action of the element. The arrangement of coils, shown in figs. 3 and 4, in the frame of unoxidisable metal, M, N, O, P, shows that the plate is free to expand vertically and laterally; the ribbons can also increase freely in thickness and in length, without disturbing the construction of the frame.

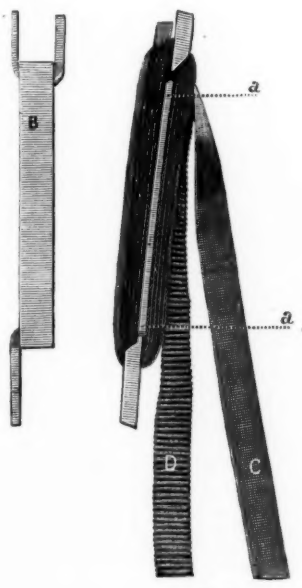


Fig. 1.

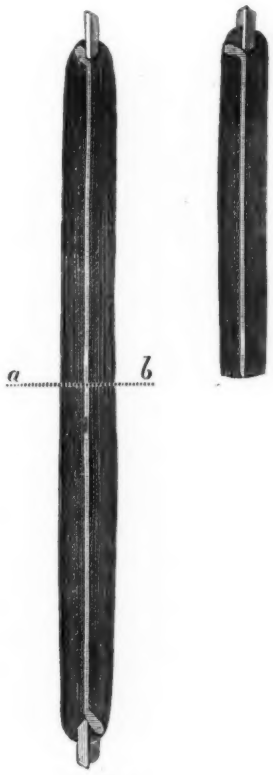


Fig. 2.

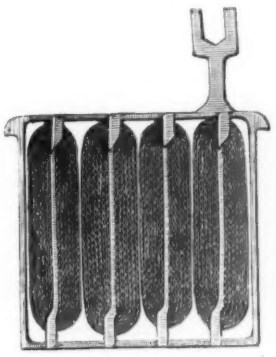


Fig. 4.

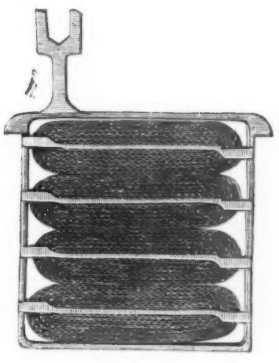


Fig. 4A.

One of the important points of the accumulator is the ingenious arrangement used by M. Blot for suspending the plates in the vessels. The plates are suspended in the liquid by means of a double frame of hard lead, *c*, *c* (fig. 5), kept at the required distance apart by two bars of lead in the form of a screw, fixed by bolts, *b*. The two frames, *c*, *c*, have at the bottom notches, *e*, in which two sheets of glass, *v*, can be placed on the edges of which the frames are hung by means of the notches, *e*, as shown in fig. 5. The plates are separated from one another by glass tubes placed between two sheets of glass or porcelain, or any insulating material, resting on the frames of the coils. Fig. 6 shows the larger type of plate.

The construction of the accumulators is exceedingly simple and mechanical. Two plates of a No. 2 cell, having a total weight of 3 kg., give a surface of 1 square metre, and it is claimed that M. Blot easily obtains at the normal rate of

discharge 10 ampere-hours per kg., which can, without difficulty, attain to 19 ampere-hours per kg. Experiments performed by D'Arsonval at the Central Laboratory of Electricity with the quarter plate element (of a weight of 1,515 g.) are summed up in the following table :—

	I.	II.
Rate of discharge in amperes estimated per kg. of electrodes (+ and −)	·86	1·33
Capacity in ampere-hours estimated per kg. of electrodes (+ and −)	19·0	15·8

After these tests the element was short-circuited, then re-

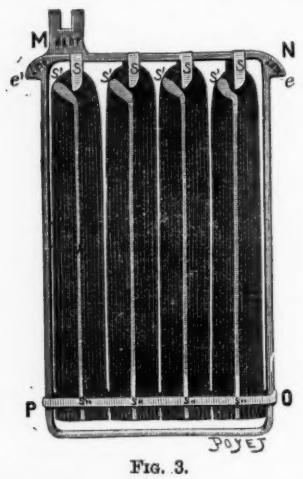


Fig. 3.

charged at the rate of 1 A per kg. It showed at the normal rate of discharge a capacity of 15 A-*h* per kg.

At the recent meeting of the Société Internationale des Electriciens, M. d'Arsonval described the results that he had observed personally for more than a year with a battery of

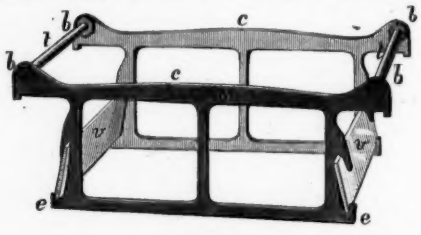
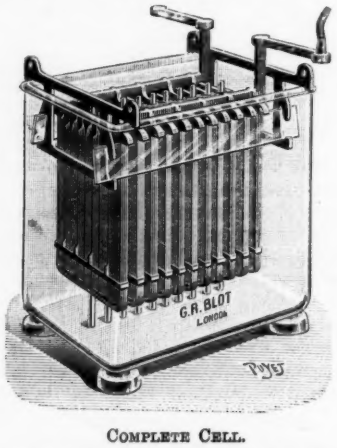


Fig. 5.

14 elements. To confirm his remarks, he quoted the assertion made by Mr. Preece when describing a great number of experiments made at the General Post Office from February 28th, 1895, to January 4th last. Mr. Preece had subjected the accumulators sent to him to most rigorous tests. For



Complete Cell.

instance, he had put them on short circuit for 10 minutes at an output of 200 amperes, until the electromotive force fell, so to speak, to zero. He then left them for 12 days to recharge them afterwards at the rate of 1 ampere per kg. He then obtained an efficiency of 79·2 in capacity, and 64·8 in energy. The plates were then taken out, washed and dried; there was no precipitate at the bottom of the vessels, and all the plates were in perfect condition.

Mr. Preece gave some curves in support of his assertions, and showed that after a short-circuiting of 5 minutes, with an output of 300 amperes, he obtained an efficiency of 80 per cent. in capacity, and 67 per cent. in energy. An efficiency of 88 per cent. in capacity and 76 per cent. in energy is obtained when discharging at 6 amperes per lb. of plate.

From these different results M. d'Arsonval concluded that this accumulator is really suited to all services suddenly demanding high powers and great variations. M. d'Arsonval added that he charged his battery of Blot accumulators on July 14th, before leaving Paris. On returning on October 23rd, the battery had lost scarcely any part of its charge. On November 20th following, two of the elements left in the open air had become sulphated; the first time they were charged they regained their original capacity. Finally, M. d'Arsonval short-circuited them for 24 hours, without finding any sign of deterioration. Lastly, he adds that it is possible to reverse the polarity and use the elements to the last, without the negative plates undergoing any alteration. The following efficiencies were stated to have been obtained at a rate of discharge of :

1 ampere per kilog.,	the efficiency was	89	per cent.
2	"	80	"
3	"	68	"
5	"	50	"
6	"	45	"

We have taken the foregoing details from the report of the *Proceedings* of the Société Internationale des Electriciens, which has recently appeared in our French contemporaries,

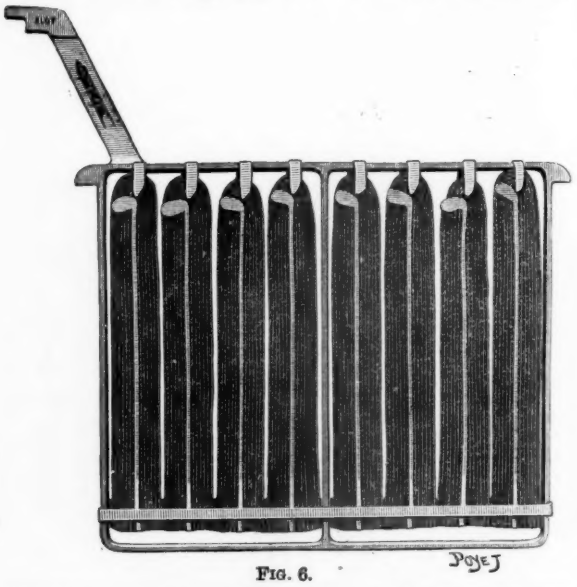


Fig. 6.

but we are assured by M. Blot that much higher results than those set forth have been obtained.

It should be mentioned, however, that a battery of these cells has been in use in the shipbuilding yard of Messrs. Lobnitz & Co., of Renfrew, for over four months, and while the normal rated discharge is given as 25 amperes, they are called upon every day to discharge as high as 80 amperes and sometimes more than 100 amperes. It is also claimed by M. Blot that the accumulator will give occasionally 15 amperes per pound of plate. There is not the slightest doubt that the figures claimed for this cell are very exceptional, and if they can be realised in practice and maintained for a reasonable period, one might be sanguine of the future of accumulators. The plates are formed electrically, and are stated to take at most a week to form. As we have already mentioned, the construction of the plates is of the most simple character, the winding of the lead ribbons on the cores being done by unskilled labour. The embossing and corrugating of the ribbon is done by special machines, which turn out long lengths in a very short time.

M. Blot, the inventor, it should be mentioned, has been located in London for a considerable period, and we believe it is his intention to open a factory in this country for the manufacture of accumulators.

THE TELEPHONE QUESTION.

The telephone question is of such general interest, that there is hardly any association in which two or three persons are gathered together for the purpose of discussion, in which it might not be made, in some form or other, the subject of a paper. The drawback to such general discussion is that, in the absence of any challenge from "advocates of the existing state of matters," the conclusions arrived at, whatever they might be, would be regarded as true! At least, so we gather from a paper read by Mr. Bennett before the East of Scotland Engineering Association at Edinburgh, on the 5th inst., of which an abstract appears in another column. In this paper the Post Office and the National Telephone Company come in for about equal shares of reproach. The late Postmaster-General is said to have refused a license to the Glasgow Corporation in effect by "prevaricating" about his promise to grant additional licenses. But the process of reasoning, by which the various conclusions are arrived at, is the most remarkable feature of the paper. Competition, in some form or other, is the great aim. It has been alleged that competition has resulted in disadvantage to the public. In combatting the assertion, Mr. Bennett alludes to the experience of the United Kingdom, where, without exception, competitors have been absorbed. The facility with which competition may be undertaken is pointed out in great detail, whilst it is shown that in the case of Sheffield, in which town the National Telephone Company was a late arrival, its competition at low rentals was ineffective against the company already on the ground, which, in fact, had to be purchased at a profit. The opinions of recent Postmasters-General and responsible officials, who have to consider the interests of their Department under present conditions, are dismissed as not deserving of attention, whilst the opinions of departed Postmasters-General formed under other conditions, and of late officials who have no responsibility at all, and who are not shown to have given adequate attention to the subject, are regarded as conclusive. Mr. Forbes expressed the opinion that capital could not be obtained for competition on limited tenure. Sir Edward Watkin had expressed the opinion that capital could not be obtained for the Manchester Ship Canal, but the capital was obtained. The illustration certainly shows that sanguine anticipations of interested parties are not always borne out; but does not the Manchester Ship Canal also convey some lessons with regard to the sanguine anticipations of promoters as to costs and profits?

Were we not so thoroughly assured of Mr. Bennett's earnestness, and of his ardent desire to be instrumental in providing telephonic communication after his own heart, we should be disposed to wonder whether his papers were not prompted in the interests of the "advocates of the existing state of things." Nothing is more calculated to draw closer the relationship of two parties than to roundly abuse them both. Few things are less calculated to promote new enterprises than over sanguine views expressed upon insufficient data and incomplete comparisons. The telephone question is not one which it is desirable for the public to ignore, and it is well they should understand that the policy of the Post Office, inaugurated under Mr. Arnold Morley, was a sound one, because it faced the situation and recognised facts. Some efforts had previously been made to meet the difficulties half way, with results which we anticipated. To abuse the Post Office is a tolerably safe line when "playing to the gallery," but it should not be forgotten that in guarding its own interests the Post Office is guarding the interests of the public. The Government are the real holders of the monopoly, and the working for the present, remains in the hands of their licensees.

In the meantime the absence of competition is an advantage to the licensees. To many that is doubtless ample reason for objection. To us it is not so, for we believe that the public advantage is also served. The "existing state of things" will not last for ever. When it is ended, it is well that the public should have confidence in the Post Office. The solution will require tact and knowledge, and, perhaps, some firmness. The licensees may with safety be left to fight for their own hand; they must be treated with justice, but there is a very general impression that they do not deserve more. We do not need reminding that cheap telephones are advantageous, nor that Sir Rowland Hill had a hard fight for penny postage, but we may remind our readers that all efforts at the amelioration of telephonic conditions alleged to be in the public interest have, in the past, been turned to the advantage of the existing licensees. The most recent and most notable instance deceived every one but ourselves. There is now a direct responsibility on the Government through the Post Office, and we believe that reliance may be placed upon it. The time will come when the Post Office, as the guardian of the public interest, may need public support, and any efforts to weaken the confidence of the public in their responsible officials will not result in the public advantage. It is for that reason that we now call attention to the paper in question, and deprecate the attitude of the author upon the subject.

REVIEWS.

The Engineer's Year Book of Engineering Formulæ, Rules, Tables, Data, and Memoranda. By H. R. Kempe. London: Crosby, Lockwood & Co., 1896.

This year book now appears on its third year of publication, with numerous emendations suggested by friendly criticism, and with the general corrections necessary for bringing such a work into line with latest rules and regulations. Many old pages have been omitted which have appeared to be of only slight value, and new ones have been added, containing information on brakes for engine testing, on the bursting strength of tubes, a subject of renewed interest with the increase of superheaters and tubular boilers. The section on mining has been revised by Mr. E. H. Davies, the mining expert, and generally the book has been brought nearer to the ideal. We would suggest an extension of the table of hyperbolic logarithms, to include every tenth, as far as, say, 30 or 40, in place of as now, only to 10, for 10 is by no means the limiting coefficient of expansion in steam engines, and it is chiefly steam engineers who use the hyperbolic logarithm.

The electrical section, of nearly 40 pages, contains a good assortment of matter, including tabulated sizes and outputs of dynamos, accumulators, dimensions of cables, &c., a class of information of which the general engineer is every day more likely to find useful, and which older men especially have had least opportunity to acquire, so rapid has been the growth of the new industry.

The value of a book like this lies very largely in its being brought fairly up to date in respect of its matter. Indeed, we have sometimes thought that if some one would only go to the trouble of abstracting the real information from trade catalogues, and publishing the same in book form without even the addition of any rules or formulæ, such a book would find a ready sale. Engineering design to-day is very largely a question of suitably assembling details made by a dozen different firms. Very few manufacturers make every part of their machinery, and a draughtsman never works without the aid of trade catalogues to enable him to design commercially, which is half the battle in securing low tenders, unless he happen to be in the office of some great Westminster man, when, of course, the object to be aimed at is the avoidance of manufacturers' sizes; a little foible that we regret to say is peculiar to this country, and accounts for so much of the success of competitors abroad.

Fifty Years' History of the Development of Green's Economiser. Manchester: Geo. Falkner & Sons.

When a manufacturing firm issue a book on their own goods it is not perhaps in human nature to be expected that they will not to some extent sound their own praises, and when we say this book is largely a sample of special pleading for the Green economiser, or flue feed heater, we do not mean to imply that it has no value. It is practically a history of the economiser up to date, and in it is described not simply the economiser according to Green, but many, perhaps all, of the patents for details taken out by other people. These are, it is true, described with a running commentary of criticism from the Green point of view, and

while in many cases the criticism is just it is not so in all. For example, the criticism of bottom box, Fig. 60, does not seem to us to take into consideration the principal intention of the sloped bottom as a mud-box and blow-out, nor is fig. 62, though perhaps copied from the blue book, exactly representative of the mode of construction intended to be carried into effect by the inventor, who, whatever his faults, had his heart in the improvement of the economiser. This fig. 62 design, as modified by the inventor, has its merits. We have had to deal with many broken caps arising from the faults it was intended to remedy. Sir E. Green's patent, No. 8,651 of last year, for means of preventing the sweating of the lower ends of pipes, was proposed years ago by the present writer, and published in more than one engineering paper as an economy not only of economiser pipes but also to avoid the use of a hot bye-pass such as Messrs. Green still suggest.

The circulation type of economiser is referred to somewhat fully. Of this it may be said that tests do not show any particular advantage to either type, but the circulatory system has disadvantages which tell against it, and our own opinion is that for large economisers the dividing up of the pipes into two or three sections of the ordinary type placed in series, is quite as far as one need go in practice along the lines of circulation. The section devoted to tubular boilers is very interesting, for it shows how very closely the designs of Messrs. Green resemble modern tubular boilers. Superheating, too, was provided for by arrangement of pipes in the flues many years ago by Messrs. Green. Though not much used in the South of England where coal is dear, there is hardly a factory in the coal districts without its economiser. Just why coal economy should be sought after with coal at 5s., and neglected with coal at 15s., is one of those things no fellow can understand, unless it be that factories are so much alike that their coal consumptions are comparable, and electrical stations are all so unlike, that the same incentive to economy—personal rivalry—is absent. But certain it is that Messrs. Green have attained their present enviable position as makers of a high class article by saving "pennorths" of coal, because they could not persuade the purchasers of dear coal to save shillings.

CORRESPONDENCE.

High Frequency Currents.

In your issue of January 13th, 1893, there is a short article on high frequency currents, by Mr. A. A. C. Swinton. Would the apparatus therein specified enable me to produce the much-sought-after X-rays, and, if so, can you tell me where I can obtain it, and also a sufficiently exhausted vacuum tube? I note that Mr. Swinton used a continuous current. By screwing up the contact breaker of the induction coil, and using an alternating current, I could, I suppose, produce an equally good result?

The dimensions—diameter length—of the core of the oil insulated coil, are not given. Can you suggest those likely to give the best results?

I am afraid I am putting your good nature to a severe test, but the subject is of such interest that a large number of your readers will be almost as grateful for any information as will be

Enquirer.

In reply to the above, it is not necessary to employ a high frequency coil to take photographs by the Röntgen method. Any ordinary Rhumkorf induction coil, capable of giving at least a 3-inch spark in air, and better if it will give a 4 or 5-inch spark, will do, if connected to a sufficiently exhausted vacuum tube of the proper shape. Vacuum tubes of the right description can be obtained from Messrs. Poths, 3, Creechurch Lane, Leadenhall Street, and Messrs. Henderson, 70, Finsbury Pavement. It is doubtful whether it would be found possible to work the Rhumkorf coil with an alternating current, it would be better to work it with primary or secondary cells.

A. A. C. Swinton.

Ozone and Refractory Ores.

A line must be drawn somewhere or there would be no end to the correspondence on ozone and gold, which, I am sure, has already become tedious. There is no animosity or "anonymosity" in my criticisms. I should like to know the name of the eminent man who has compared the specification of the wonderful new ozoniser with the Beanes specification, the more so as there *is no* Beanes specification, *no* Beanes patent. I should like also to know the name of the very leading chemist in London who has tested the application of ozone for the treatment of refractory auriferous ores and has reported favourably. He must be a bold man to commit himself to such a statement!

I am certainly more enthusiastic about ozone than Colonel Engledue, and I believe more in its future than he does, simply because I have an experience of several years daily practice, which he has not. I wish him heartily to succeed in his adventure and when the discouraging difficulties, the unforeseen and disappointing stoppages or breakdowns heap up, I shall be too glad to help Colonel Engledue if possible, and give him the advice of one who thinks he knows how to produce ozone and what ozone can or cannot do.

E. Andreoli.

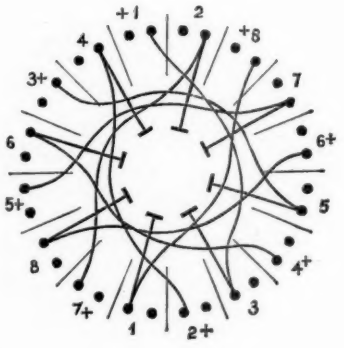
[We think this matter had better rest for a while.—Eds. Elec. Rev.]

Information Wanted.

Will you kindly help me out of the following difficulty?

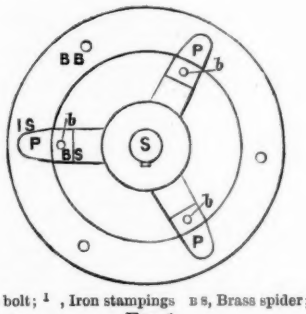
I have completed a dynamo, the armature of which becomes hot after 20 minutes run without any load. It is built up as follows:—

The rings are composed of iron stampings, "each insulated with one thickness of tissue paper," 6 inches diameter outside and 4 inches diameter inside, all fastened together with



three brass bolts; they were bored in lathe, and made a driving fit on brass spider, as shown in sketch.

It is well insulated and wound with 128 coils of No. 12 S. wire. This, at 1,800 revolutions per minute, gives 100 volts.



B B, Brass bolt; I, Iron stampings B S, Brass spider; S, Shaft.

Fig. 1.

In your opinion, should the brass spider and bolts be in metallic contact with iron stampings, or should they be insulated.

I also enclose sketch showing method of winding, 8-part commutator being shown, instead of 32, for simplicity.

As you will observe, the end of No. 1 coil joins beginning

of No. 3, and end of No. 3 to beginning of No. 5—5 to 7—and the end of No. 7 to beginning of No. 2, &c.

Trusting you will point out where I have erred,

Fitter.

February 4th, 1896.

[The brass bolts will cause heating, and they are apparently the whole length of the armature and right in the lines of induction.

You can put on iron end plates, P, P, P, on the spider ends by bolts through holes, B, B, B, in fig. 1; after these are screwed firmly up you can withdraw the brass bolts in the core. You will require to rewind the armature after this is done.

Faulty insulation may also cause some heating effects.—Eds. Elec. Rev.]

The Art of Electric Welding.

Re electric welding, I shall be greatly obliged if you will allow me to make the following corrections in your next issue with reference to two points in your interesting article which appeared in last week's issue entitled "The Art of Electric Welding."

Firstly, the tube sections referred to on page 171 should read T-*sections*.

Secondly, the bicycle tyres referred to on same page should read *carriage tyres*.

For and on behalf of

The Electric Welding Company, Limited,
Reginald J. Wallis-Jones,
Engineer and Manager.

February 8th, 1896.

Transformer Plates.

Mr. Ernest Scott has somewhat unwarrantably assumed that I have fallen into the common error of supposing that the Mordey transformer is invariably built up as described in text-books.

As a matter of fact, I saw "Mordey" transformers being built up in the orthodox text-book manner at the Brush Company's works at Loughborough, not more than a year ago.

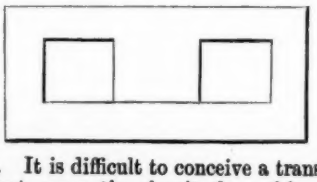
Since transformers of this type were actually made by the Brush Company until quite recently, they should be quite respectable transformers even from the practical man's point of view.

The type of plate described by Mr. Scott is not unknown to me, as I had ample opportunities of observing the construction of transformers built up in this manner at the Brush Company's works.

Although there is no waste of iron in the Mordey transformer described by Mr. Scott, there is very little to commend this method of construction; in the first place there is a multiplicity of parts, there being no less than four differently shaped stampings.

Mr. Mordey evidently believes in providing the maximum number of air-gaps, each of which tends to increase the no-load current; while he has, I believe, always advocated a short magnetic circuit with the avowed object of diminishing the no-load current, an apparent inconsistency. With so large a number of loose plates to manipulate it is a matter of great difficulty for a workman to ensure the stampings being properly butted together so as to form a good iron circuit.

It is possible to use a plate with one split only, as shown in the sketch below, the centre portion being bent back to



pass the coils. It is difficult to conceive a transformer with a more efficient magnetic circuit than this, especially if alternate plates are arranged to break joint, and the whole is firmly clamped together.

George Adams.

Bedford, *February 10th*, 1896.

The Wiring Question.

In consequence of the publicity recently given in the columns of yours and other electrical papers to the discussions and criticisms of electric light wiring, &c., I presume to ask for a portion of your space in order to bring into general notice a number of points which, though bearing strongly on the question, never seem to get a fair share of consideration.

On various occasions when the subject of discussion has been connected with electrical work, I have noticed that when it has become necessary to use condemnatory terms in speaking of a system or style of work, the objections are so framed as to throw the stigma on the class of men who have actually done the work.

Now, although this may be perfectly right and proper to some extent, what should be said of the engineers and contractors who wilfully and persistently employ incompetent and unskilled labour at low rates of pay with the idea (a mistaken one, no doubt), of being able to contract for work at a low figure, and get their work done cheaply?

I do not think I am past the mark when I say that one-half of the electrical installation work carried out in this country for the past six or seven years has been done by firms whose men have been for the most part such as I mentioned above. In fact, were a census of hands employed in the electrical industry, especially in installation departments, to be taken at the present time, it would be found to be made up in a great measure of the cast-offs and overflush of trades and professions many of which bear about the same relation to electrical engineering as a teapot to an elephant.

Personally I know of cases where, on installation contracts, out of a dozen men engaged wiring, &c., perhaps one, or may be two, have been all that could lay any claim to the title of electrician, or even wireman.

Of course, the contractor, or whoever was supposed to be carrying out the work, has generally proved wise enough to arrange so that the particular points most likely to arouse suspicion should be attended to by the one or two skilled men, and not by the great half-paid. It has been urged before now by employers of labour that this system, properly supervised by a practical foreman, who can instruct the men in the methods of their work, and watch them well while they do it, is not in any way detrimental to the trade or to the work; and although this is to a certain extent true, my experience has been that to "properly supervise," as they call it, such a system would require a "practical foreman" for every working man, and I feel assured my experience can be backed up by many others.

Now I maintain that if electrical firms would adopt the principle of employing more skilled and competent workmen, of whom there are plenty to supply their demands, but who are kept in the background by the cheap (?) system, there would be a great deal less to say about bad work; there would be fewer complaints of exhorbitant charges for current from consumers, and there would no doubt be a corresponding decrease in the troubles of the central station engineers, arising from leakage on their external circuits. In short, better work, better results, and better, instead of worse, chance of competition would come of it.

It is well known that if a plumber, gasfitter, or sanitary engineer is desirous of carrying out work in his own particular line, he must first satisfy the authorities, town council, county council, or whatever they may be, as to his ability to do so, as it is considered that incompetent persons interfering in such matters causes risk of damage to life and property. Yet in the matter of electric wiring, where the dangers are greater, and damage caused likely to prove more disastrous still, any kind or condition of man is allowed to work without even a question as to his knowledge of what he is doing.

I am not by any means a strong advocate of trade union principles as carried out in connection with many trades in this country, but as a remedy for some of the evils I have mentioned, and as a means of obtaining results most beneficial to all branches of the electrical profession, commercial or otherwise, and also to the general public, I consider that a combination of practical men formed for the purposes of resisting encroachments on their rights, maintaining a standard of ability, and working in harmony with employers, of whom it should receive the sanction and support, would effectually meet the requirements, and I feel assured that, if

such a thing could be brought into actual practice, there would be less of the "wiremen beware" about than we have been treated to lately.

I may say that I have written this letter at the instigation of a few fellow-workmen who, like myself, have suffered from the evils of which I have complained, and have come to the conclusion that it is high time something was done in the matter, and I hope you will give the desired prominence to this letter, which I hope to be the means of showing a side of the question not often considered.

I enclose my name and address, and remain,

Floreat Electra.

February 10th, 1896.

Aluminium.

In your issue of January 31st there appears an article by Mr. Addenbrooke, reviewing the progress of the aluminium industry during 1896. I read this article with considerable interest, especially that part referring to the relative conductivity of aluminium and copper, but I was somewhat disappointed to find that no reference was made to the making of joints in aluminium wires.

As far as I am aware, there has not yet been discovered a "flux" which will enable one to make a good, durable, well-sweated, and satisfactory joint in aluminium wires and cables. May I take it that the absence of any reference to this matter bears the inference that the flux which will do for aluminium what resin does for copper, is not yet known to those intimately connected with the aluminium industry?

E. A. Browning.

February 8th, 1896.

LEGAL.

Electric Lamps in Chancery.—Cross Motions.

In the Chancery Division of the High Court of Justice on Friday and Saturday last, Mr. Vernon Smith, Q.C., moved before Mr. Justice North on behalf of Julius Sax & Co. (electrical engineers), to rectify the register of designs, by striking off the register design No. 206,807, registered by J. C. Clarke, on the ground that it was not novel, and that similar designs had been used before. The learned counsel said that this design consisted of a lamp used for an electric light to light shop windows, and was practically identical with, or similar to, lamps that had been used before for gas.

Mr. Swinfen Eady, Q.C., in opposition to the motion, claimed that the design was novel, inasmuch as its adaptation to electricity required invention. He had a cross motion against the defendants for infringement.

It was arranged to treat both motions as one.

Mr. Smith said if his Lordship was against him on the motion to rectify, he should submit that his lamp was not an infringement, and that, looking at the lamps that were in the market at that time, it was not a fraudulent design or an imitation of the plaintiff's lamp.

Mr. Eady said that the plaintiffs and the defendants were not strangers, as the latter had entered into an agreement with the plaintiff for the supply of certain lamps, and there was an action now pending in the Queen's Bench Division because the defendant had obtained lamps from somebody else in direct breach of the agreement.

After hearing the affidavits and arguments,

Mr. Justice North, in giving judgment, said that in his opinion both the motions failed. He could not say that the plaintiff's design was so entirely without novelty that it ought not to be registered, and in his opinion the defendant was not infringing the plaintiff's rights in what he had done. The result was, he must dismiss both motions, and the costs would be set off.

Judgment accordingly.

Gaskell and Another *v.* Gosling & Sharpe.

An appeal in the action of Messrs. Gaskell and another, a Staffordshire firm and makers of the porcelain parts of electrical apparatus, against the London banking firm of Gosling & Sharpe, as holders and trustees under a deed granting second debentures in the electrical firm of Poole & White, Limited, Bread Street, London, raised this important question on Wednesday before the Master of the Rolls and Lords Justices Lopes and Rigby, appeal being made to them from a judgment of the Lord Chief Justice, who heard the case and found for the plaintiffs. It appeared that in 1892, Poole & White had become indebted to defendants in this case, who were their bankers, in some £3,000, and, to secure them the amount, gave them second debentures and made them trustees under the debenture deed to cover this debt. Previous debentures to the amount of £7,000 had been granted by Poole & White. In July of the year in question, Goslings conceiving their security to be in danger, under their deed entered into possession of Poole & White's concern—through Mr. Kelly, a receiver, and he carried on the business. But, in September, on the petition of a creditor, a compulsory winding-up order was made, and an official liquidator was appointed. Kelly, however, continued in the active direction of the business until February, 1895, and, opening an account at Gosling's bank, the debenture holders drew from it their half-yearly interest. In 1893 a representative of the plaintiffs, calling at Poole & White's and seeing Mr. Kelly and ascertaining that the business was being carried on, they supplied goods to the amount of about £700 on the orders of Mr. Kelly, chiefly for the purpose of working up materials in the possession of the firm. On this account, £488 was due when the first debenture holders, in the exercise of their powers, entered into possession of the undertaking and turned Mr. Kelly out. The question then arose who should pay the plaintiffs, and, bringing the action which the Lord Chief Justice heard, it was contended that the goods having been supplied to the receiver for carrying on the business and utilising the company's stock in hand, the first debenture holders, before they could take advantage of the business Kelly had transacted, were bound to indemnify those whose goods had contributed to that end. The Lord Chief Justice holding that Kelly having, in express terms, disclosed that he was acting as receiver, and it could not be doubted the defendants were the real persons carrying on the business, found for the plaintiffs. This was now appealed against, Mr. Jelf, Q.C., for the defendants, submitted that Kelly acted as agent not for the defendants in particular, but for the whole of the creditors of the liquidating firm, and consequently the defendants could not be held personally responsible. Yesterday, after arguments had been heard from counsel on both sides, judgment was reserved until this (Friday) morning.

Lazare, Weiller & Co. *v.* T. Bolton & Sons.

On Friday last the hearing of this case, to which we referred last week, was resumed, and Mr. Justice Mathew delivered judgment. He said the action was for breach of contract to deliver goods from the plaintiff in a large quantity of bars and rods to be used for telephone purposes. The contract was commercially of great magnitude, for it bound the plaintiffs to deliver, and the defendants to receive, at the rate of 200 tons per month, the bars and rods in question over a period of five years. The total amount of the contract was for £600,000. He was satisfied from what took place that the output was not regarded by either party at the time as material to this contract, or as affording any inducement whatever to the contract being entered into; therefore the case solely depended upon the question whether there was fraud or such misrepresentation as should require the contract to be set aside? In his judgment, that was the only point established clearly in favour of the plaintiffs. He understood the case on the part of the defendants to be that the contract on the face of it indicated clearly the terms upon which, and the time during which, deliveries were to be made. There was nothing to qualify in any way the obligation of the defendants under the contract signed; but it was extremely singular that the event should not be contemplated which was not at all unlikely to occur, namely, that the syndicate would fail in its operations, and fail to capture the market and obtain such control over it as would enable them to dictate prices. There was a great deal of opposition from different quarters, and he was not surprised to hear, as the examination of the witnesses proceeded, that that was the main subject of discussion, as they would expect it to be. It was all very fine to enter into a contract to buy off an opposition in the market, but the market did not really depend upon the syndicate and the plaintiffs. There were other quarters from which competition might arise which might have a very serious effect upon the interests of this company. What would be the position of the defendants supposing the competition was not controlled, and they did not obtain control of the prices? Why, that they would be saddled with an enormous contract for £600,000 worth of these bars and rods, and would have no recourse against anybody. If the syndicate was not properly protected against competition from America or elsewhere, the loss would be enormous. The position of things was that Messrs. Bolton would have no recourse against the other members of the syndicate, because the other members of the syndicate, having these possibilities present to their minds, had refused to enter into the contract. Now, the evidence of Mr. Weiller on the subject approaches the evidence of the defendant almost within a hair's-breadth. He had not the slightest hesitation in coming to the conclusion that by the distinct, independent and collateral agreement contained in that letter, the plaintiffs, through their managing man, bound themselves to the defendants, and that such an arrangement was valid. The defendants were liable on the contract of November 28th, 1894, and the plaintiffs were liable on the collateral agreement. He was not called upon now, and he was not prepared to say what damages were recoverable under the one contract or the other. That must be a subject for further discussion. He agreed with Mr. Bigham that there would be much trouble to counsel and the Court dealing with the question of damages under the two contracts. At present it was sufficient for him to say that in his opinion the two contracts were established, and the breach of either would have to be made out. He would strongly impress upon the parties the wisdom of coming to a business-like arrangement upon the matter of damages. Of course, they were not in the least called upon to act upon his judgment, and they might go elsewhere if they thought they would fare better. But assuming his judgment to stand, it would be wise that the spirit of Mr. Weiller's letter should be acted upon, and between business men there should be no difficulty in saying what the result ought to be. If they preferred the hard views of the lawyers, at some future day convenient to them and counsel, he should be prepared to discuss and decide the question of damages. He reserved the question of costs for the present. Judgment accordingly.

South *v.* Dodge & Co.

On Tuesday, in the Westminster County Court, the case of South *v.* Dodge & Co., came before his Honour Judge Lumley Smith, Q.C., upon a judgment summons. The application was for a declaration as to who were the partners in the firm who carried on business in Cecil Court, Charing Cross, as electrical engineers. It was stated that the sole partner in the firm at the time the debts were contracted was Charles Dodge, and the son Nelson, whom the plaintiff wanted to make liable, was only a servant, although afterwards he became a partner with Mr. W. A. Fraser, who now carried on the business, but as the necessary capital was not introduced, the partnership was dissolved, and the sole member of the firm was Mr. Fraser. At the time this debt was incurred Nelson Dodge was an infant, and he admitted in the box that his father, who was over 70, was a retired farmer, and knew absolutely nothing about the business of an electrician. He was the practical man in the business at this period. His Honour was of opinion, after looking at the assignment and other documents, that the business at this time was Charles Dodge's, and that even if the son was a partner he was an infant at the time, and he could make no order of committal against him. Plaintiff's solicitor pointed out that the father had a bill of sale over his furniture. His Honour: I have no doubt it is a juggle, and you have been cheated out of your money. The solicitor: We are not the only people in the trade. The judgment was amended from "Dodge & Co." to "Charles Dodge, trading as Dodge & Co."

BUSINESS NOTICES, &c.

Bankruptcy Proceedings.—The adjourned public examination of the officials of Ronald A. Scott, Limited, was resumed before His Honour, Judge Bagshawe, at the Brentford Bankruptcy Court on Wednesday, last week. Mr. Ronald A. Scott was further examined by Mr. Mercer, the official receiver. His Honour adjourned the examination for the production and identification of the quarterly accounts received by Mr. Reeves from Mr. Scott, and for all letters between them having regard to the business.

On Tuesday, at the Halifax County Court, a receiving order was made on the debtor's own petition in the estate of Charles Frederick Fox, electrical engineer, residing at 14, High Street, and carrying on business at 1, Bond Street, Halifax. The liabilities are estimated at £450. Assets are not yet known.

George A. Reakes, electrical engineer, Shrewsbury, attended Shrewsbury County Court on Tuesday for examination in bankruptcy. His assets amounted to £137, and deficiency to £769. The examination was adjourned for the production of further accounts.

Dissolutions of Partnership.—Messrs. F. Jordan, R. Davidson, A. M. Davidson, and A. E. Jakeman, hitherto carrying on business as A. McGlashan & Co., at 20 and 22, Goldsmith Street, Drury Lane, London, as engineers, coppersmiths and brass founders, have dissolved partnership by mutual consent. Debts will be attended to by A. E. Jakeman.

Messrs. G. Walker, J. Walker, and W. G. Walker, hitherto carrying on business as Walker & Co., at 81, Camden Street, Birmingham, as general brass founders, &c., have dissolved partnership by mutual consent. Debts to be attended to by W. G. Walker.

Extensions.—A Stafford paper says that the works at Bushbury of the Electric Construction Company, Limited, are to be extended owing to the growth of the trade. The cost is estimated at £10,000, and will give employment to a large number of hands.

Fire.—A fire occurred in the factory of Bell's Asbestos Company, Limited, on Friday morning last, but it will not in any way interfere with business.

For Sale.—From our "Official Notices" it will be seen that the business, stock-in-trade, and effects of an electrical engineer are being offered for sale as a going concern at Halifax, by the Official Receiver, Mr. Thos. England.

New Business.—Mr. Fred A. Donnison and Mr. Fred Berlyn, who have been associated with Messrs. Roger Dawson, Limited, since the formation of this company, have started business on their own account as electrical engineers, under the style of Fred A. Donnison, Berlyn & Co. They inform us that, during the building of their new extensive show rooms and premises, they are occupying temporary offices at 8, Great Portland Street, W.

Ornamental Wood Casings.—A very prominent maker of wood casings, in speaking to an Electrical Review representative, says that electrical engineers rarely purchase other than the very plainest wood casings. Whether this is due to the fact that the trade is not fully aware of the many ornamental ones that are made it is impossible to say, but it is curious that combined cornice moulds and casings, skirting boards and casings are very rarely adopted by electrical men, even when cost does not enter into the question.

Price Lists.—Messrs. A. Whitelaw & Son, of Edinburgh, have sent us an illustrated list of the Grange gas engine of ½-brake horse-power, suitable for driving light machinery, such as small dynamos, &c

ELECTRIC LIGHTING NOTES.

Ambleside.—The District Council has resolved to oppose the provisional order to be applied for by the Windermere and District Electricity Supply Company, and to apply for an order to supply electricity itself.

Bangor.—The Council are to erect a new gasometer, it being stated that this is necessary whether electric lighting is undertaken or not.

Bedford.—On Thursday night last week current was turned on to the public lamps over about a third of the borough.

Bradford.—The Finance Committee of the Corporation, on 7th inst., consented to application being made to the Local Government Board for power to borrow £40,000 for electricity works extensions.

Burnley.—There is a proposal to instal electric light at St. Peter's Church, but it is stated to be necessary for special mains to be laid. It is also suggested to lay the mains along Omerod Road, School Lane, and Bank Parade at the same time.

Camberwell.—It was proposed at the last meeting of the Guardians that Messrs. Allen & Son be asked to report as to the probable cost of installing the electric light throughout the workhouse buildings, the engine and boiler already fixed to be used for the purpose. The matter has been referred back to the House Committee.

Cheltenham.—The Electrical Engineer recently reported that applications for current had recently been received, which necessitated extensions of the mains. He is to bring up a report of the probable extension and estimated capital expenditure during the next six months, with a view to applying for sanction for a further loan.

Clacton.—The result of a short discussion *re* electric lighting for Clacton last week was the reference of the question to a committee, who are to make inquiries and report.

Colchester.—The Council appointed, last week, a special committee to carry out the construction of the electric light works. Mr. W. H. Massey had stated that the fees and expenses for preparing a statement, advising *re* schemes and tenders, and superintending the construction of the works should not exceed £500. He was appointed consulting engineer upon these terms.

Croydon.—On the report of the General Purposes Committee, a discussion arose at the last County Council meeting with reference to the proposed lighting of the centre of the town with arc lamps, the estimated extra cost of the lamps over the price now paid for gas being from £300 to £400 per annum.

Derby.—£5,612 has been granted by the Council for electric lighting purposes, the main feature of which will be the laying down of larger cables. The salary of the engineer at the station (Mr. Stewart) has been increased from £5 per week to £6 per week.

Dover.—At the meeting of the Managing Committee last week, the Town Clerk brought up the terms of the contract with the Electric Supply Company, for the lamps on the sea front and in Snargate Street. The question of the design of lamps for Market Square was referred to the lighting committees of the wards.

Dundee.—Regarding the recent breakdown, Mr. Brownlee, the engineer, has now submitted his report.

Edinburgh.—The Town Council is to light the police cells by electricity, the installation costing £180. One speaker said it was wanton waste of money. It was absurd that a prisoner, after breaking a policeman's skull, should be treated to electric light Turkish carpets, &c.

Glasgow.—A Sub-Committee from Glasgow visited Edinburgh recently, and inspected the electric lighting there for the purpose of instituting a comparison between the undertakings of the two towns. The result is, that Glasgow representatives have weighed the Glasgow system in the balance, and found it sadly wanting. The comparison of the street lighting comes out as follows:—

	Glasgow.	Edinburgh.
Lamps erected, and in course of erection	112	441
Charge per lamp per annum ...	£26	£20 (shortly to be reduced to £18)
Average amperage per lamp erected...	10	11½
System of distribution	low tension	high tension

It is not surprising, therefore, that the Committee finds that the street lighting of Edinburgh is much better than that of the street lighting in Glasgow, and that that result has been obtained by a more judicious employment of the light, and they recommend that the matter be remitted back to them to consider and report as to what measures are necessary to improve the present system of the electric lighting of the streets of the city, with power to confer with the

Electric Lighting Committee of the Corporation. They also strongly recommend that the Electric Lighting Committee of the Corporation appoint some of their members to co-operate with this Sub-Committee in further investigation. The Police Commission has adopted this recommendation. One of the speakers stated that the fault at Glasgow lay in the adoption of the low tension system.

Halstead.—The District Council has arranged with Messrs. Crompton & Co. to send down an engineer to view the town, and report *re* electric lighting for a fee of 10 guineas.

Hammersmith.—Preparations are in progress for the erection of the central station buildings in Fulham Palace Road. The surveyor is to prepare the necessary plans.

Horfield.—A committee has been appointed here, by the District Council, to consider advisability of installing, and the cost of the electric light.

Huddersfield.—The Local Government Board has sanctioned an application of the Corporation for power to borrow £50,000 for the purpose of extending the electric lighting works and plant of the Corporation, the amount to be repaid in 25 years. The previous loans on electric lighting account amount to £50,000.

Islington.—Ratepayers in Wharfdale and Pentonville Roads want the electric light, but at the last Vestry meeting Mr. Lambert stated before any more streets could be supplied more money would be wanted.

Liverpool.—The Prince's Landing Stage is now fitted up with electric lamps, and on the arrival of the ss. *Campania* last Friday night ten lights were brought into use.

London.—An installation has been carried out at the new premises of the Salvation Army Bank and General Insurance Office, under the supervision of Mr. F. H. Taylor.

London County Council.—At the weekly meeting on Tuesday, the Council resolved to lend a certain sum to the Metropolitan Asylums Board for the laying of mains for electric lighting. Sanction was given to the County of London and Brush Provincial Electric Lighting Company to lay mains and construct transformer chambers in Wandsworth; to the Kensington Company for the construction of street boxes and new mains; to Hampstead Vestry for a sub-station in Compayne Gardens, and new mains; and to St. Pancras Vestry for new mains in Gower Street, &c.

Morecambe.—An agreement for the purchase of the Morecambe Electric Light and Power Company's undertaking and plant for the sum of £3,897, was executed the other day by the District Council, and the chairman was empowered to convene a public meeting to ratify the same.

Much Woolton.—The Council is to oppose the application of the Liverpool District Lighting Company.

Reading.—The electric light installation at the Free Library is nearly completed. Nothing has yet been heard from the Local Government Board regarding the Council's application to borrow £8,000.

South Africa.—The *British and South African Export Gazette* gives the following details of electric lighting and power plant for South Africa:—The Transvaal Government has accepted the tender of Messrs. Delfos Bros., Pretoria, for the electric installation of the State Printing Works.—Messrs. Thomas Robinson & Son, Limited, Rochdale, have received an order for the electric lighting installation of Mr. T. Mitchell's new mills, at Ficksburg, Cape Colony.—Messrs. Findlay & Co., the Cape Town agents for the Edison-Swan Company, have received the contract for the installation of the electric light at the Dutch Reformed Church, Adderley Street, Cape Town.—Two electric motors have been shipped for the Sheba Company, to take the place of the two at present at work on its property.—Orders are to be given out for additional electrical plant for the Princess Mine.—An electrical motor has been procured for Moodie's Fortuna Mine.—An electrical pumping plant has been ordered for the Robinson Deep Mine.—It has also been decided to substitute an electromotor for the Marshall engine on this mine as soon as the large compound engine in the mill has been duplicated.—The Barberton Reefs Company have, we believe, been making inquiries with Messrs. Johnson & Phillips, electrical engineers, of Charlton, Kent, about a 300-H.P. electrical plant, divided into six motors of 50 H.P. each.

Southwark.—The St. Saviour's District Board of Works has consented to the application of the County of London and Brush Provincial Company for a provisional order, but only in respect of a certain specified district.

Stafford.—The quarterly account for the electric current, which came before the Gas Department recently, amounts to £250 odd. The accounts for electric fittings for the quarter, including service charges, came to £596 odd. 36 consumers are now on the books. Mr. Bell, the engineer, estimated that the revenue from the supply of the electric light for the ensuing 12 months would be about £1,000, and then he believed they would make both ends meet, and be able to pay their way without any charge on the Corporation.

Sunderland.—The Highways Committee had before them a few days the estimate of the Electric Lighting sub-Committee for the half-year ending September 30th next. They expect to expend £1,541 2s. 9d., but with the estimated receipts £960 15s. for supply of light, rent of meters, &c., there will be a deficit of £580 7s. 9d. to be provided for. In the corresponding half-year the actual amount to be provided was £642 9s. 3d. against an estimate of £990 18s. 6d. In the current half-year the requirements were put down at £1,599 15s. 3d., the estimated receipts at £1,282 16s. 8d., leaving £316 18s. 7d. to be provided. The estimate was approved. The committee decided to join with other corporations in opposing an application of the patentee of the three-wire system for a renewal of his patent, which will shortly expire. At present the Council pay a royalty of £50 a year, and if they can prevent the renewal of the patent this will be so much money saved. It was decided to recommend the Council to subscribe a guinea a year to the funds of the Municipal Association of Electrical Engineers, of which the electrical engineer of the Corporation is a member.

Swansea.—As stated last week, Mr. W. H. Preece, to whom the triple scheme, as proposed by Mr. Manville, was referred by the Council, has endorsed the proposals already made. An abstract of Mr. Preece's report is now given in the local press. He states that the proposed generating station on the Strand site at the foot of Welcome Lane is a convenient one, and he finds no flaw in Mr. Manville's estimates, which place the cost of the complete installation, together with the purchase of land, at £45,314. The method of working recommended for adoption is the high tension alternating current transformer system, to supply 12,500 lamps fixed, and Mr. Preece, taking four towns having populations approximating to that of Swansea, finds that the capital actually expended per lamp fixed was:—Brighton £4 8s. 5d., low pressure; Portsmouth £3 12s. 11d., high pressure; Burnley £3 1s. 9d., low pressure, and Huddersfield £3, high pressure. The mean is £3 10s. 9d. 12,500 lamps, multiplied by the mean, equals £44,218 15s., which is a very close approximation to Mr. Manville's £45,314. The revenue expected is £7,608, allowing for the consumption of 88,000 units for public lighting at 2d. per unit, and charging 6d. per unit for energy supplied for private lighting—a fair and proper charge in such a place as Swansea. . . . . With reference to the question of a destructor, Mr. Preece says destructors in many places have become an absolute necessity, and the Corporation's borough engineer had given excellent reasons, financial and sanitary, why a destructor should be fixed at the Strand site; but the question was, could it be economically attached to the generating station. Mr. Preece admits he has had no practical experience of destructors, and very little trustworthy information, he adds, had been published of the calorific value of ashbin refuse; but it is certain that the amount of water evaporated by such refuse was very variable. "My conclusion," he says, "is that, while the destructor may act as a steam raiser, it certainly will act as a feed water heater. . . . . The use of the destructor does not affect the success of the electric lighting scheme in any way. It simply affects the price of the electrical energy to the consumer, by reducing the working expenses. Hence, on economical grounds, I fully support the principle of combining the destructor with the generating station." "It is proposed," says Mr. Preece, "to supply the tramway companies with electrical energy, so as to work their railway by electricity. The tramways in Swansea at present do not seem to be very remunerative, and the hilly character of the place is not conducive to the longevity of the horses. . . . . The acquisition of the tramways by the Corporation is a question of policy on which I cannot express an opinion; but whether they can be worked by electricity, and whether the energy can be effectively and economically supplied by the generating station, are questions on which I can express my views. . . . . "If, then, anything is likely to make the tramway system a financial success in Swansea, it is by working them efficiently as electric railways." Mr. Preece says there can be no question of the practicability of the electric system, nor any question of its economy, if the energy can be supplied in the power house at 1½d. per unit delivered, for this unit represented just the power required to propel a car at the maximum speed allowed for one mile, and the price was less than that of horseflesh. The question, then, was, could electrical energy be advantageously supplied from the generating station at this low figure? Mr. Preece then gives a table of the cost of production in six large towns during 1893 and 1894, showing the variation according to the growth of load. Thus, at Bradford, in 1893, the units sold were 480,614, and the cost per unit at the works was 2·15d., while in 1894, 554,633 units sold cost 2·02d. In Manchester the cost fell from 2·41d. in 1893 to 1·49d. in 1894, when the units sold went up from 439,379 to 1,168,382. "Here the fact is strikingly developed," says Mr. Preece, "that the greater the load the cheaper the cost of production. That the economy would be still further developed by a more continuous load admits of no denial. Hence, it is evident that if the load at the Strand generating station were increased from 363,000 units to 1,000,000, the cost of production ought to be reduced from 3·3d. per unit to 1·49d., the price at Manchester; but, as the period of working would cover all the daylight hours, and would continue during the working of the trams, and form a practical day-load, and thus considerably flatten the load curve, the cost per unit ought to approach 1d. It is proposed to apply the alternating currents to motors, which, in their turn, drive continuous current dynamos, from which the energy will be stored up in accumulators. This system is in use in Rome, and, I am told, working very satisfactorily. Accumulators are in use in the Isle of Man in England, and are used very largely on the Continent in the way proposed in Swansea. I see no practical difficulty in carrying out Mr. Manville's recommendations. I think, therefore, that a minimum of 400,000 units delivered to the tramway company at 2d., a minimum of 600,000 at 1¾d., and a minimum of 750,000 at 1½d, is well within the region of practice. . . . . I have come to the conclusion that the Corporation would be quite safe in adopting Mr. Manville's several recommendations. On their own individual intrinsic merits, each part of the so-called triple scheme is practical and promising. They mutually support each other for the benefit of the ratepayers. The price charged for the light could be reduced to a figure below that of any other town in the United Kingdom."

Train Lighting.—We hear that Messrs. J. Stone & Co., who are promoting the system of train lighting by electricity, to which we referred at some length recently, are making experiments on some of the coaches of the Great North of Scotland Railway Company at Kittybrewster. The first of the new carriages so fitted was turned out on the 6th inst.

Walsall.—The baths are to be lighted by electricity, at a cost for fitting of £120.

Wimbledon.—A letter has been received from the Board of Trade expressing their willingness to renew the Council's electric lighting license for a period of two years, and the Council has decided to again make application to the Local Government Board to sanction the loan required for the purposes of electric lighting.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Accumulator Traction in Belgium.—The tramway company in Antwerp is making some experiments with accumulator traction on its horse tramways in that city. The accumulators adopted are of the Hagen type.

Belfast Tramways.—The report of the Belfast Street Tramways Company contains a statement to the effect that the question of electric traction has been under consideration, and the directors consider the time has arrived for its application to Belfast. With this view they have introduced a Bill into Parliament for the necessary powers to be granted to the company. They hoped to come to an equitable agreement with the Corporation, but if not, the Bill would be dropped, as they were determined not to spend any of the shareholders' money in "unnecessary parliamentary litigation."

Blackburn Tramway Scheme.—The shareholders of the Blackburn Corporation Tramways Company, Limited, the other day voted against adopting electricity as a motive power. The details were given in these columns last week.

Bristol Tramways.—The report of the Bristol Tramways Company, for the half-year ended December 31st, 1895, shows an increase in the receipts of £4,887. Reference is made to the opening of the Bristol-Kingswood electric section, the working of which has proved very satisfactory.

Cork Proposed Electric Tramways.—Plans prepared by Mr. Walsh, C.E., have been lodged with the local authority in connection with a scheme to provide electric trams for portions of the City of Cork and some of the suburban districts. It is proposed by the promoters to run a series of lines to Blackpool, Lower Road, St. Luke's, Western Road, and Douglas Village, connections being made with the city railway stations.

Dublin Councillors at Bristol.—A party of the members of the Dublin Corporation visited Bristol last Friday, and inspected the electric tramways and the power station. Mr. J. Clifton Robinson accompanied the deputation.

Sheffield Tramways.—At the meeting of the Sheffield Tramways Company last week, the chairman, speaking of electric traction, said the company had applied for power to use electricity or other force upon their lines. The shareholders, at a subsequent special meeting, resolved to make application for a Bill to authorise the working by means of electrical or mechanical power.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Communication in Japan.—We learn by the last Japanese mail that the submarine cable to be laid between Marugame and Osaka, and between Shimonoseki and Saga, had arrived from England, and that the work of laying the same is now in hand.

Telegraphic Interruptions and Repairs.—The following notifications were registered at Berne up to noon on 12th inst:—

February 8th, 3.55 p.m. Eastern Company notifies that there is no more delay on messages between South Africa and Europe.

February 10th, 8.45 a.m. Moussoul-Bagdad restored.

February 10th, 3.50 p.m. Saigon-Bangkok restored.

Telephonic Communication with Japan.—Some experiments are being made by the Japanese Communications Department in connection with the establishment of telephonic communication between Kobe and Tokyo, and between Nagoza and Tokyo.

The Amazon Telegraph Company, Limited.—The managing director of this company informs us that cable communication between Para and Manaos, the capital of the province of Amazonas, has been successfully completed. Messages of congratulation have been exchanged between the directorate in London and the Brazilian Government in this regard. The line is now open for messages between these two places, thus bringing "Manaos" in direct telegraph communication with Europe and the rest of the world.

The Export Trade in Telegraph Wire and Apparatus.—The returns regarding the exports from this country of telegraph wire and apparatus connected therewith, during last month, show that this branch of trade has opened the year comparatively quiet. The value of the exports only amounted to £57,224, as compared with £296,145 in the preceding month. They, however, show an increase over the corresponding month of last year, when the value was only £35,193.

CONTRACTS OPEN AND CLOSED.

OPEN.

Austria.—March 1st. The Municipal Authorities of Brünn are inviting tenders for the establishment of a central station in the town for the generation and supply of electrical energy for lighting and power purposes, including that necessary for an electric tramway. Tenders to be sent to the Burgermeisteramt der Landeshauprstadt, Brünn, Austria.

Canary Islands.—February 29th. Tenders are being invited for the 35 years' concession for the electric lighting of Sainte Croix de Teneriffe, Canary Islands. Tenders to be directed to the Ministère de la Gobernacion in Madrid, Spain.

Eston.—May 1st. The District Council invites schemes for lighting the district by electricity, such schemes to embrace (*a*) plan and estimated cost; (*b*) annual working cost and maintenance. Particulars from the District Surveyor, Grangetown, Yorkshire.

France.—February 15th. Tenders are invited by the municipal authorities of Beziers (Herault) for the concession for the construction and operation of a system of electric tramways of a total length of 8 kilometres in the town. Tenders to be addressed to La Mairie de Beziers (Herault).

France.—February 27th. Tenders are invited by the General Direction of the French Posts and Telegraphs for the supply of 125 tons of copper or bronze wire. Tenders to be directed to the Direction Générale des Postes et des Telegraphes, 103, Rue de Grenelle, Paris.

France.—February 28th. The General Direction of the French Posts and Telegraphs is inviting tenders for a quantity of telephone cable and six lots of material for telephone batteries. Tenders to 103, Rue de Grenelle, Paris.

Italy.—February 28th. Tenders are being invited by the Municipal Authorities of Parma, an important old town about 60 miles from Milan, for the concession for the electric lighting of the public streets for a period of 15 years, commencing June, 1897.

Keighley.—March 4th. Tenders are invited for providing telephonic communication between the various buildings forming the infectious hospital now in course of erection at Morton Banke, near Keighley, for the Keighley and Bingley Joint Hospital Board. Particulars on application to Mr. Alfred Moore, clerk of the works at the hospital.

Menston.—February 17th. The Committee of the West Riding Asylum, Menston, is inviting tenders for the supply of telephones and electric bells for the new buildings and houses upon the estate. Specification to be seen at the County Surveyor's Offices at Wakefield, and at the Clerk of Works' Offices at the Asylum.

Sunderland.—March 13th. The Corporation invites tenders for engines, dynamos, boilers, &c., for the electric supply station. Details will be found among our "Official Notices."

CLOSED.

Birkenhead.—The tender of Messrs. Drake & Gorham (£215) has been accepted for the wiring of the Town Hall for electric lighting for the Corporation.

Bradford.—On 11th inst., the Council confirmed the acceptance of the tender of Messrs. Siemens Bros. & Co., Limited, for the supply of two dynamos required at the proposed new electricity works in Valley Road, for £2,650, and the tender of Messrs. Willans and Robinson, Limited, for the supply of two 600 indicated horse-power steam engines for £4,400.

France.—The French Posts and Telegraphs authorities have placed the contract for 100 kilometres of submarine cable core with the Société Industrielle des Telephones of Paris.

Shoreditch.—The following tenders were submitted to the Vestry for proposed electric lighting buildings (boiler-house and engine room), at Pitfield Street, Hoxton:—

	£	s.	d.
Nightingale, Albert Embankment	10,494	0	0
Manlove, Alliott & Co., Limited, Nottingham ..	10,540	16	0
Shelbourne & Co., Fenchurch Street	10,005	5	9
Kirk & Randall, Woolwich	9,442	0	0
Jarvis & Sons, Hackney Road	9,926	0	0
Chessum & Sons, Haggerston	9,499	0	0
Wilkinson Bros., Finsbury Park	9,971	0	0
Coulsell Bros., Bethnal Green	9,383	0	0
Pattinson & Sons, Whitehall	8,854	0	0
Atherton & Dolman, Poplar (accepted)	8,535	0	0

St. Pancras.—The following is a list of the tenders sent in for wiring and fitting St. Pancras Vestry Hall and Offices for electric lighting for the St. Pancras Vestry:—

	£	s.	d.
Maple & Co., Limited	553	11	3
Roger Dawson, Limited	528	15	8
H. F. Joel & Co.	477	7	10
H. Binks & Co.	449	16	6
Rashleigh Phipps & Co.	445	0	0
Vaughan & Brown	440	0	0
E. P. Allam & Co.	434	0	0
Benham & Son, Limited	437	7	2
Julius Sax & Co., Limited	436	7	2
Pettit & Hards	426	0	0
Strode & Co.	419	10	6
J. W. Whitaker	404	16	0
Spagnoletti & Crookes	399	4	6
Drake & Gorham	396	16	8
Electrical & Engineering Company	388	15	0
William Whiteley	382	11	7
Graham & Biddle	374	1	5
Hollingham & Saward	372	10	6
Fowler, Lancaster & Co., Limited	372	7	9
Thorpe & Waring	350	10	0
Carter Bros.	340	5	0
Peter Jones	336	17	0
C. A. Hemingway	333	8	6
L. Alwyn	331	0	0
Laing, Wharton & Down	304	6	6

NOTES.

A Staffordshire Combination.—For some three months past, says the *Birmingham Gazette*, the manufacturers of china furniture and electrical appliances have been constantly meeting with the object of preventing the serious underselling which has made this branch of the potteries trade absolutely unremunerative. Mr. E. J. Smith was consulted, and the manufacturers resolved to adopt his scheme of combination, including the fixing of selling prices upon the basis of cost, and the alliance with the workpeople. The association has been formed, every (?) manufacturer having joined. The officers appointed are Mr. William Woodall, M.P., president; Mr. J. T. Harris, vice-president; Mr. E. J. Smith, chairman; and Mr. W. Arthur Addinsell, of 112, Edmund Street, Birmingham, secretary. A meeting of manufacturers and operatives was held at the North Stafford Hotel, Stoke-on-Trent, on Saturday, Mr. William Woodall presiding. Mr. Smith addressed the meeting, and explained the terms of alliance, and a resolution was unanimously passed by the operatives approving the scheme, and pledging themselves to complete the alliance as soon as practicable.

Accidents Due to Gas.—There was a gas explosion at Doncaster Parish Church on 7th inst., the new Vestry being demolished, and some stained glass windows damaged, the total loss being estimated at about £2,000. In March, 1895, the authorities, after going into the question of cost, decided not to light the church by electricity, on account of expense. Other churches should take note of the course of events at Doncaster before coming to a similar decision. Electric light is cheaper than a fairly good gas explosion.

On Monday night a rather serious gas explosion occurred at a house at Newport. The occupant was burnt about the face and hands.

Curious Blunders.—A curious error occurs in Mr. Park Benjamin's work on "The Intellectual Rise in Electricity." An experimenter is stated to have "held his *wife* in his left hand and felt a smart shock the instant the circuit was closed."

Sir Henry Roscoe's recently published "Life of Dalton" recounts a delicicus answer of one of Dalton's pupils when asked to describe Dalton's atomic theory. It consists, he said, of cubical shaped pieces of wood painted various colours.

The Royal Society.—The following papers were down for reading before this Society yesterday afternoon:—Dr. J. N. Collie and Prof. Ramsay, F.R.S., "On the Behaviour of Argon and Helium when submitted to the Electric Discharge." Lord Kelvin, F.R.S., "On the Generation of Longitudinal Waves in Ether." Prof. J. J. Thomson, F.R.S., "On the Discharge of Electricity produced by the Röntgen Rays, and the Effects produced by these Rays on Dielectrics through which they pass."

The Institution of Electrical Engineers.—At a Students' Meeting held in the Library of the Institution, 28, Victoria Street, on Friday last, February 7th, a paper was read "On the Construction of a Form of Wheatstone's Bridge Box," by Gustave J. Lemmens, student.

Lord Kelvin's Jubilee.—At a joint meeting of representatives of the Corporation of Glasgow and of the Court and Senate of Glasgow University, Lord Provost Bell intimated that the Town Council had appointed a committee, consisting of the five senior magistrates and himself, to deal with the arrangements for the celebration of Lord Kelvin's jubilee as a professor in the University. The Lord Provost suggested that the celebrations should take the form of a banquet in the Municipal Chambers, to be followed next evening by a *conversazione* in the University. It is likely that the celebrations will take place towards the end of June.

Conversazione.—The students of the City and Guilds Technical College, Leonard Street, Finsbury, are holding their biennial *conversazione* on Thursday, February 20th, and Prof. Silvanus P. Thompson, D.Sc., F.R.S., has promised to prepare a lecture for the occasion on "Invisible Light and its Photography," a subject suggestive of recent discoveries and current scientific topics. The lighter portion of the programme consists of a concert and dance, while the whole of the College not used in the entertainment is to be given up to exhibits of model machinery, electrical appliances, and chemical manufactures.

Correction.—A correspondent points out a slight error which occurred in the article which appeared last week on the "Niagara Falls Power Plant." At the top of page 167, right-hand column, the clause, "as the *armature* rotates," was obviously a misprint for "as the *field* rotates."

The Three-Wire System Patent.—We understand that the Corporations of Edinburgh, Glasgow, Belfast, Aberdeen, Brighton, Hull, Bradford, Lancaster and Sunderland are combining to oppose the application of the Westinghouse Electric Company for an extension of the three-wire distribution system patent. A deputation from these Corporations met on Monday last at the offices of Messrs. Martin and Leslie, Parliamentary agents, London.

South Kensington Museum.—We are requested to state that the arrangements are now complete for lighting in the evening the "Southern Galleries" of the South Kensington Museum, on the west side of Exhibition Road, which contain the collections of machinery and naval models. These Galleries will be open free to the public from February 17th on three evenings a week—Mondays, Tuesdays and Saturdays, till 10 p.m.—in the same manner as the main building.

Congratulations.—We have pleasure in offering Mr. C. J. Stewart our hearty congratulations upon his appointment as Clerk to the London County Council, at a salary of £2,000 per annum. Our readers will well remember Mr. Stewart as official receiver in connection with the liquidation of Woodhouse & Rawson United, Limited, and other companies. The dignified affability and the thoroughness with which he conducted such proceedings were most marked.

Resignation.—The resignation of Dr. Holder, the chairman of the Hull electric lighting committee, on account of pressure of work is to be exceedingly regretted, for he has laboured well at Hull in connection with the electric lighting undertaking.

Society of Arts.—On Tuesday next, February 18th, at 8 p.m., in the Foreign and Colonial Section, a paper on "The Development of Electrical Traction Apparatus" will be read by H. F. Parshall (General Electric Company, U.S.A.). W. H. Preece, C.B., F.R.S., Vice-President of the Society, will preside.

Dundee Clocks.—The Dundee Burgh Engineer and City Architect have been instructed to report as to the controlling by electricity of all the public clocks in the City and Harbour.

The Institution of Electrical Engineers.—At a students' meeting to be held in the library of the Institution, 28, Victoria Street, on Friday, February 21st, at 8 p.m., the following paper will be read: "Some Central Station Experience," by W. Fennell, student.

Lectures.—Mr. Frederick Headley delivered a lecture on "The Modern Use of Electricity" before the Plymouth Mechanics' Institute last week.

Mr. William Lynd, of London, delivered one of his very interesting lectures at the Bradford Mechanics' Institute on 4th inst. He took for his subject "The Electric Telegraph from 1837 to 1896."

The Franklin Institute Awards.—The Franklin Institute proposes to award the John Scott Legacy medal and premium to the following:—Lieut. George O. Squier and Albert C. Crehore for their "Polarising Photo-chronograph;" Joseph Richards for his "Solder for Aluminium;" A. Langstaff Johnston for his "Bonding Joint for Electric Railways."

The Röntgen Rays.—It is stated that Prof. Salvioni, of Perugia University, has succeeded in rendering the Röntgen rays visible by means of a special instrument, which he calls the iristoscope. By this means, it is thought practical applications of an unexpected nature will be made possible.

At the annual meeting of the Royal Photograph Society, on Tuesday, after the formal business, in which Captain Abney, R.E., was elected president, an interesting demonstration of photography on the lines of Professor Röntgen's process was made by Mr. A. A. Campbell Swinton. At the conclusion the president spoke in congratulatory terms of Mr. Swinton's demonstration, and regarded it as strong evidence of the electrical phase of the Röntgen rays.

Autocars.—A deputation from the Self-Propelled Traffic Association, on Wednesday, waited on the President of the Local Government Board at the House of Commons. Their object was to urge upon the right hon. gentleman the desirability of amending the Locomotive Act, or of introducing a new Bill to facilitate locomotion on highways. The deputation, which was introduced by Sir David Salomons, included Mr. Shaw Lefevre and Sir Frederick Bramwell.

Cochrane v. Exchange Telegraph Company.—In delivering judgment in this case, on Wednesday, Mr. Justice Chitty said the plaintiff urged that the defendants were monopolists, and had therefore a duty imposed upon them to create no preferences in regard to the supply of news. He (Mr. Justice Chitty) held, however, that the license from the Postmaster-General under the Telegraph Acts, in virtue of which the defendants carried on their operations, transmitted nothing to them in the nature of a monopoly, and therefore this point was unsuccessful.

Catalogue Files at the Patent Office.—The London Chamber of Commerce has been in communication with the Comptroller-General of the Patent Office, expressing its appreciation of the great importance of having a complete collection of illustrated and other trade catalogues, &c., for reference at the Patent Office library. Sir H. Reader Lack has replied, stating that the nucleus of a collection has been in existence there for about 20 years, and from time to time has been gradually extended; but he has expressed his willingness to consider suggestions as to means of rendering the collection more complete and accessible.

Institution of Civil Engineers.—According to notice filed in Tuesday's *London Gazette*, a petition has been presented to Her Majesty in Council, praying for a grant of a supplemental charter. The petition is to be considered by a Committee of the Lords of the Council on February 25th.

Modern Apparatus.—Mr. Buckley, whose paper recently read at the North-Western Electrical Association is appearing in another part of this paper, makes many good hits. Here is one—It is an apt illustration of the eternal fitness of things that the electrical apparatus, built to repair easily, soon develops a determined disposition to accommodate you.

NEW COMPANIES REGISTERED.

Cox Thermo-Electric Company, Limited (46,731).—This company was registered on February 3rd with a capital of £100,000, in £10 shares, to adopt an agreement with H. B. Cox and others, and to acquire, develop, turn to account, and deal with certain inventions relating to the direct generation of electricity from heat by means of thermopiles or thermo-electric generators. The subscribers (with one share each) are: H. P. Cox, 59, Ashley Gardens, S.W., engineer; Mrs. C. L. Cox, 59, Ashley Gardens, S.W.; W. Churcher, The Avenue, St. Margaret's, S.W., solicitor; J. Macfarlan, 7, Rothwell Street, Regent's Park, clerk; T. Dunsdon, 53, Shrubland Road, Walthamstow, clerk; E. Dry, 43, Northumberland Park, N., book-keeper; H. Elliott, 32, Chichester Road, Leytonstone, clerk. The number of directors is not to be less than four, nor more than six: qualification, £500; remuneration as the company may decide. Registered by Lawrance & Co., 14, Old Jewry, E.C.

Fowler-Waring Cables Company, Limited (46,740).—This company was registered on February 4th with a capital of £200,000 in £5 shares, to acquire the business of a company of the same name (registered in 1889), to enter into an agreement with the said old company, and to carry on business as telegraph, telephone, and electric light cable and wire manufacturers, electrical engineers, and contractors, &c. The subscribers (with one share each) are:—G. Fleming, 9, Billiter Street, E.C., merchant; A. E. Mavor, 32, Victoria Street, S.W., electrical engineer; Lord Medway, J.P., 2, Cadogan Square, S.W.; W. Chamberlain, Harbourne Hall, Birmingham, manufacturer; G. F. Smart, 25, Jermyn Street, S.W., gentleman; W. Fowler, 6, Lombard Street, E.C., engineer; W. Mackintosh, 6, Lombard Street, E.C., secretary. The number of directors is not to be less than three nor more than seven; qualification £200; remuneration £2,000 per annum, divisible. Registered office, 32, Victoria Street, S.W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Telegraph Improvement Company, Limited (15,475).—This company's annual return was filed on January 2nd. 15,006 shares have been taken up out of a capital of £100,000 in £1 shares, 15,000 are considered as paid, and £6 has been paid.

Ernest Scott and Mountain, Limited (32,760).—This company's annual return was filed on December 4th. The capital is £70,000 in £10 shares, and 5,763 have been taken up. 2,200 are considered as paid. £10 per share has been called on 1,082, £6 5s. per share on 1,981, and £5 per share on 500; and £25,701 5s. has been paid. £4 10s. has been paid on one forfeited share.

Foreign and Colonial Arc Accumulator Company, Limited (34,021).—This company's annual return was filed on December 11th. The capital of £1,000 in £1 shares has been taken up, 993 shares have been issued as paid, and nothing has been called on the rest.

Epstein Electric Accumulator Company, Limited (34,528).—This company's annual return was filed on January 29th. The capital is £101,000, in 100,000 ordinary and 1,000 founders' shares, all of £1. 70,307 ordinary and 1,000 founders' have been taken up, and 70,007 ordinary and 1,000 founders' are considered as paid. £300 has been paid on the rest.

Europe and Azores Telegraph Company, Limited (39,452).—This company's annual return was filed on December 31st. The capital is £200,000, in £10 shares, and 16,704 have been taken up; 5,568 shares have been issued as paid, and £111,360 has been paid on the others.

CITY NOTES.

The Yorkshire House-to-House Company's Account.

A CONSIDERATION of this company's accounts for the year 1895 impels us to look up our remarks on the year 1894. We then congratulated the company on arriving at the lowest coal figure of any alternating current station. This year they have achieved a veritable triumph, for not only have they beaten their own previous figures, they have established a record of ·3d. for coal. We need hardly say this achievement makes the Leeds Company an actual first in the competition of low coal costs. As we published the directors' report in our issue of January 31st, it is hardly necessary to refer to the commercial operations of the company, except to say that a dividend of 5 per cent was paid on the ordinary shares. The works' costs for 1894 were 2·15d., against 1·45d. obtained for 1895. As a matter of fact, the total costs this year are less than the works' costs were for the previous year. Mr. Green, the secretary of the company, has kindly furnished us with the following table, showing the number of 35-watt lights installed at different periods:—

January 1st ...	19,858	July 31st... ...	28,634
„ 31st ...	20,343	August 31st ...	29,222
February 28th ...	20,634	September 30th ...	30,038
March 30th ...	26,848	October 31st ...	30,882
April 30th ...	27,416	November 30th ...	31,646
May 31st	27,740	December 31st ...	32,539
June 20th... ...	27,986		

	1893.	1894.	1895.
Total capital invested	—	£56,476	£76,020
Number of units sold	—	291,113	524,629
Number of lamps connected ...	—	19,858	32,539
Revenue from sale of current ...	—	£7,245	£11,274
Net revenue	—	£3,709	£6,780
Average price obtained per unit..	—	—	5·1d.

Cost of Production.	£	s.	d.	Per unit.
Coal	670	0	0	·30d.
Oil, waste, water, and engine room stores	352	0	0	·16d.
Salaries and wages at generating station	1,767	0	0	·80d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	417	0	0	(Works' cost) 1·45d. ·19d.
Rates and taxes*	313	0	0	·14d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges and insurance	1,206	0	0	·57d.
Depreciation of buildings and plant account	1,300	0	0	·59d.
Renewal fund account	2,000	0	0	·91d.
Total	£8,025	0	0	3·66d.

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	11,274	0	0	5·1d.
Meter rents	—			—
Sale of lamps	—			—
Total	£11,274	0	0	5·1d.

* Includes interest on mortgage on land and buildings.

Total cost per unit (exclusive of depreciation and renewal accounts), 2·16d.; works' cost, 1·45d.

The Westminster Accounts.

THE Westminster Electric Supply Corporation is one of the most stable of Metropolitan supply companies. One generally expects to find the annual report a record of steady progress, and the recently issued accounts show no exception to those issued previously. From a shareholder's point of view, the year 1895 is the most successful in the history of the company, for a dividend of 7 per cent. is to be paid on the capital of the company, and with the steady increase in the lamp connections, there is little reason in anticipating that the profits are likely to fall off. The statement of the directors is as follows:—

"The supply of current which, on December 31st, 1894, was provided for the equivalent of 167,703 lamps of 8 C.P., had increased by December 31st, 1895, to the equivalent of 210,982, and at the present time there are on circuit the equivalent of 216,822 lamps of 8 C.P., and applications have been received for a further 6,478. The length of roadway in which mains have been laid now exceeds 39 miles, making about 156 miles of ways, into which upwards of 123 miles of copper (strip and cable) have been drawn. The plant and machinery have been working satisfactorily throughout the year, and have been fully maintained from revenue, and a further reduction has been effected in the cost per unit, in generating, distributing, and general expenses. In consequence of the increase in the business of the Corporation, the directors have found it necessary to acquire additional property at Eccleston Place and Millbank Street. In dealing with the revenue of the past year, your directors have, after writing off bad debts, a portion of preliminary expenses, and placing £953 to credit of sinking fund, added a sum of £9,780 to the depreciation account. The net revenue of the year amounts to £23,731 11s. 9d., out of which an interim dividend, at the rate of 5 per cent. per annum, for the half-year ending June 30th, 1895, has been distributed. The board now recommend the payment of a dividend at the rate of 9 per cent. per annum, less income-tax, for the past half-year, making 7 per cent. for the year ending December 31st last, carrying forward a balance of £1,338 14s. 10d. The holders of founders' shares becoming entitled to a share of the surplus profits, after payment of a dividend of 7 per cent., this balance will be carried forward as follows:—Ordinary shareholders' undivided profit account, £1,004 1s. 2d.; holders of founders' shares undivided profit account, £334 13s. 8d. The premium of £8,000 received on the issue of new shares has been carried to the credit of the reserved fund, and invested. In accordance with the articles of association, two of the directors, James Heslop Powell, Esq., and J. Browne Martin, Esq., retire; but being eligible, offer themselves for re-election."

There is naturally a reduction in the cost of production, the works' cost being 1·46d., against 1·69d. for the previous year; the total cost being 2·40d., against 2·71d. The following is an analysis of the cost of production:—

	1893.	1894.	1895.
Total capital expended ...	£381,276	£411,018	£443,843
Number of units sold	1,704,615	2,173,298	2,830,396
Number of lamps connected ...	131,565	167,703	216,822
Revenue from sale of current...	£41,949	£50,168	£65,554
Net revenue	—	—	£28,962
Average price obtained per unit	5·9d.	5·5d.	5·5d.

Cost of Production.	£	s.	d.	Per unit.
Coal	6,775	0	0	·57d.
Oil, waste, water, and engine room stores	1,321	0	0	·11d.
Salaries and wages at generating station	6,755	0	0	·57d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	2,484	0	0	(Works' cost) 1·46d. ·21d.
Rates and taxes	3,131	0	0	·26d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges and insurance	8,012	0	0	·68d.
Depreciation of buildings and plant account	9,780	0	0	·83d.
Sinking fund account	953	0	0	·08d.
Total	£39,211	0	0	3·31d.

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	65,555	0	0	5·5d.
Meter rents	3,051	0	0	—
Sale of lamps	—			—
Total	£68,606	0	0	5·5d.

Total cost per unit (exclusive of depreciation and renewal accounts), 2·40d.; works' cost, 1·46d.

Burnley Corporation Accounts.

LAST year we gave considerable prominence to the exceptionally good results obtained by Mr. Thursfield at Burnley for the year 1894, but excellent as were the figures for that year, they have been completely overtopped by those for 1895. There has been, of course, a considerable increase in the output, the number of units sold during the period under review being 124,933, against 74,383 for 1894. This is practically an increase of 50,000 units, but a lower price has been operating for some portion of the year, for the average price obtained per unit is 4·9d., against 5·64d. for the previous year. From the subjoined table it will be seen that there has been a substantial increase in the profits for the year, the net revenue gaining to the extent of £660. An analysis of the cost of production, however, reveals the most interesting features of the year's work; indeed, we do not hesitate to say that it constitutes a record, for the size of works. Indeed, it is not far behind the phenomenal Leeds figures, where the output is almost four times as large. Certainly no other works besides Leeds and Burnley have up to the present analysis achieved the feat of bringing the cost of coal below ·4d., and an inspection of the items in the analysis will prove interesting. At Burnley, coal figures out at ·38d., which compares with the previous figure of ·62d. The decrease is maintained throughout the various items, with the result that the works' cost stands at 1·26d.—the total costs, exclusive of contribution

to sinking fund, being 2·13d. A balance of £343 16s. 1d. is carried to the Borough Fund; and, altogether, we may take it that the Corporation Works are in an exceedingly flourishing condition. Mr. Thursfield is to be most sincerely congratulated on obtaining such excellent results:—

	1893.	1894.	1895.
Total capital invested ...	—	£20,727	£24,250
Number of units sold	—	74,383	124,933
Number of lamps connected ...	—	6,708	—
Revenue from sale of current...	—	£1,746	£2,558
Net revenue	—	£829	£1,489
Average price obtained per unit	—	5·64d.	4·9d.

Cost of production.	£		1895. Per unit.	1894. Per unit.
Coal	200		·38d.	·62d.
Oil, waste, water and engine room stores	59		·11d.	·17d.
Salaries and wages at generating station	326		62d.	·84d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	77	(Works' cost 1·26d.)	·15d.	·17d.
Rent, rates and taxes	171		·33d.	·53d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges, and insurance	292		·56d.	·77d.
Depreciation of buildings and plant account	—		—	—
Sinking fund account	440		·84d.	·94d.
Total	£1,565		2·99d.	4·05d.

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	2,558	0	0	4·9d.
Meter rents	92	0	0	—
Sale of Lamps	—			—
Total	£2,650	0	0	4·9d.

Total cost per unit (exclusive of depreciation and renewal accounts), 2·13d.; works' cost, 1·26d.

The India Rubber, Gutta Percha, and Telegraph Works Company, Limited.

THE directors' report for 1895 is a little more lively than it was in the previous year. It was then considered that the company had had a very bad time, but the shareholders can certainly take heart of grace from the present report, which, if not startling, is certainly satisfactory. The net profits last year were £41,961, against £49,325 for this year. The directors state that:—

"The annexed accounts show, after provision for doubtful debts, a net profit for the past year of £49,325 12s. Adding £20,913 17s. 4d. brought forward, and deducting £12,500 interim dividend paid in July, there remains a disposable balance of £57,739 9s. 4d. The directors recommend the distribution of a dividend of 15s. a share, free of income tax, amounting to £37,500, making, with the interim dividend, a total payment of 10 per cent. for the year, and leaving £20,239 9s. 4d. to be carried forward. The year's general business has been satisfactory, and the cable department and steamships have been moderately employed. The Silvertown and Persan factories are in good order. Before the next accounts are presented the directors will propose alterations in the company's articles of association as to the form of balance-sheet and profit and loss account in accordance with the suggestion of the auditor. The company's 4½ per cent. debentures are repayable next month, and it is intended to issue new debentures at 4 per cent."

Anglo-American Telegraph Company, Limited.

THE half-yearly general meeting of the Anglo-American Telegraph Company, Limited, took place on Friday last at Winchester House.

The MARQUIS OF TWEEDDALE (the Chairman) said:—The report which I have to submit to you to-day is the best that we have been able to present to you since 1892. In the half-year ending 1892 we paid you a dividend of £1 10s. per cent.; in 1893 it fell to £1 6s.; in 1894 to £1 3s.; and this half-year we are able to recommend a dividend for the half-year at the rate of £1 8s., of which 10s., as you know, has already been paid, leaving a balance of 18s. The increased dividend is due, first, to improved traffics, secondly, to an increase in our receipts from the steamship *Minia*, and, thirdly, from a considerable reduction in our expenses. The increase in traffic amounts to £15,764, due, of course, to the great improvement which has taken place in commerce and business, an improvement which I hope is destined to continue. The *Minia* has earned for us £1,350 more than last year, and we are able to report a decrease of expenses amounting to £1,056. This decrease in expenditure is all the more satisfactory inasmuch as it compares with the half-year, when the decrease amounted to no less than £3,399. I have now before me on the table a comparative statement of the working expenses for the half-years ending in December since 1891. This shows a steady decrease from that year to the present year of no less than £8,712. Our renewal fund now stands at the respectable figure of £624,265. The value of the securities at the close of the half-year shows an increase of no less than £74,000. In connection with the renewal fund, I may mention that, owing to the lease of our offices in Threadneedle Street coming to a termination, we purchased the lease of very suitable offices in Old Broad Street, the cost of the thirteen years' lease being £28,541. The offices are very superior to those that we had before, and I am glad to say that, with the receipts from letting off a certain portion of the building, the cost is within a pound or two, the same as that of the offices which we have relinquished. The condition of our cables is very satisfactory. It is true that during the half-year we have not been altogether free from interruption, but, with the exception of the 1873 cable, which was interrupted in the present half-year, and repaired on July 16th, the interruptions have been confined to our short cables west of Newfoundland, and to the cable—for there is only one instance—in the shallow sea. The repairs to these cables have been executed with the skill and promptitude exhibited by our officers both in the ship *Minia*, commanded by Captain Trott, and also by our local officers at St. Pierre, who, in the face of very great difficulties, from weather and otherwise, repaired one of our most important short cables with perfect success. The report refers to the French case, and that, I am sorry to say, is not any nearer, or very little nearer, settlement than it was when I last met you. I need hardly say that it is not from any want of energy on our part, but, owing to French lawyers being, not unlike our own, not disposed to be in too great a hurry in the settlement of such matters. But the present position is this—the French counsel have had the matter in hand for many months, and it is understood that the company's case is in draft and is not yet settled. When it is settled it will be proceeded with before the proper Court, and I hope to be able by our next meeting to report some settlement. I do not know that the report calls for any further observation. I am glad to be able to inform you that the new half-year has commenced in a manner which augurs very well for our meeting six months hence. The Chairman concluded by moving, "That the report of the directors and accompanying statement of accounts to December 31st, 1895, submitted to this meeting be, and the same are hereby, received and adopted, and that the following dividends, as recommended by the board, be now declared and paid, less income-tax—that is to say:—1. A final dividend of 18s. per cent. upon the ordinary consolidated stock for the year ending December 31st, 1895 (making, with £1 11s. per cent. interim dividends already declared and paid by the board by way of dividends on account), a total dividend for the said year of £2 9s. per cent. on the said stock. 2. A final dividend of £1 16s. per cent. upon the preferred ordinary stock for the year ending December 31st, 1895, making, with £3 2s. per cent. interim dividends already declared and paid by the board by way of dividends on account, a total dividend for the said year of £4 18s. per cent. on the said stock."

Mr. F. A. BEVAN seconded the motion, which was agreed to, and after transacting the usual routine business, the meeting separated.

Liverpool Overhead Railway Company, Limited.

THE fifteenth half-yearly general meeting of the shareholders of the Liverpool Overhead (Electric) Railway Company was held at the Law Association Rooms, Cook Street, Liverpool, on Tuesday, 11th inst. Sir William Forwood, chairman of the company, presided over a large gathering.

The CHAIRMAN, in moving the adoption of the report and accounts, said he thought they would agree with him that they were of an exceedingly satisfactory character. He had in the past felt it necessary to adopt the *rôle* of a prophet, so as to cheer up some faint-hearted shareholders; but he did not think it was necessary to do so now. His prophecies had been abundantly realised, and he believed they would be still more so in the future. They would observe that for the half-year ended December 31st, as compared with the corresponding half of the previous year, their first class passengers had increased by 82,000, and second class by 146,000. There had at the same time been a decrease in workmen's special tickets of about 9,000, this being accounted for by the fact that at the end of 1894 they gave up the very cheap rate of 2d. return for workmen using the early morning trains. During the year, however, those workmen who had been walking to their work, or finding other means of conveyance, had been gradually coming back, the return fare now being 3d. The total number of passengers of all classes carried during the half-year was 3,780,000, the figures for the whole year being over 7¼ millions. The gross revenue for the half-year from passengers and merchandise was £31,590, an increase over the corresponding six months of £5,915; in other words, they had earned 1·97d. per passenger, as against 1·67d. in the same half of 1894. That was accounted for from the fact that they were now carrying a large number of first class passengers, and were not carrying the workmen at the former low rate. The working expenses had increased by £1,731. Their trains had travelled some 7,000 more miles, so that they had earned £5,915 more at a cost of £1,731. The working expenses, as compared with revenue, had been 60 per cent. in the half-year, against 67 per cent. in the corresponding half of 1894; but that was not all due to economy in working, though part of it was. Deducting the expenses from the gross receipts, and also the amount of debenture interest, they were left with an available balance of £10,196, to which had to be added £1,302 carried from last account, making £11,499 available for dividend. They had spent considerably more upon maintenance, repairs of structure, opening of bridges, and other works, than in the previous year. This had been done because they wished to keep the structure of the railway in the very best possible condition. They had also put aside a rather larger sum for renewal of boilers and machinery, the fund for which now amounted to £4,500. Besides that, they had started a new fund, called a con-

tingent fund. They were liable to accidents, but he was thankful to say the total amount paid by them in compensation in three years was only £15; still that was an element they should not lose sight of, and it was thought wise to establish a contingent fund, to which they had carried £100, and which they hoped would gradually grow up and constitute a substantial assurance fund. Referring to the progress made in the works of the southern extension, he was glad to say that the heading was completed, and the workmen were now busily engaged in bricking in the tunnel. Already about 250 yards were completed, and they were making such satisfactory progress that they believed that part of the line would be opened in August next. Their new station would be at the Dingle, and they believed it would prove of great convenience to the residents of that district. Every time he went there he was more and more impressed with the belief that that district would be a valuable feeder to their line. Being anxious to make their line as attractive and convenient as possible, they were making provision for a bicycle shed, so that their young friends might travel from their homes on their machines, and use the line to take them to and from the city. The railway had been maintained in the best possible condition during the year. He was pleased to say that 98·40 per cent. of the trains had been run on time, and this he believed to be a record performance. Practically, also, they had been able to maintain the service without any hitch during the entire 12 months. He believed a great deal of the credit for that was due to the determination with which they had started to maintain the service in the very best condition; and they had been very ably seconded by the engineer and manager, Mr. Cottrell, and his whole staff. To their industry and watchfulness they were very much indebted. As a proof that the public were satisfied, he stated that there had been no complaints made, though now and then they had a kindly suggestion, which they were always glad to consider. He concluded by moving the adoption of the report, and the payment of 5 per cent. per annum on the preference shares, and 3½ per cent. per annum on the ordinary shares, carrying forward £2,074 to next account.

Mr. Richard Hobson, in seconding, said it was a source of great satisfaction to know that their undertaking, after having been a long time in the region of experiment, had now passed into a sound and dividend-paying concern, and that their shares, instead of being quoted on the Stock Exchange at £5, as some gentlemen liked at one time to point to, had now reached £13.

Mr. Woodward called attention to a defect in the lighting of the trains, and said that frequently the electric light went out altogether, which was very annoying to passengers who wished to read their evening paper. It was strange that should be so, on a line worked by electricity. He had the very highest opinion as to the future prospects of the company.

The Chairman replied that they were now making some experiments in order to remedy the defect complained of. They took their light from the main conductor, and that was a varying quantity; but they believed they were now on the fair way to obtain means by which they should be able to give a constant light.

The motion was then passed unanimously.

The retiring directors, Sir Wm. Forwood and Mr. Harold Brocklebank, having been re-elected, the proceedings terminated with a vote of thanks to the chairman.

Waterloo and City Railway Company, Limited.

The half-yearly general meeting was held on Thursday last week at Waterloo Station, London, Mr. W. S. Portal presiding.

The Chairman, in moving the adoption of the report, said that he met the shareholders under very favourable circumstances. The position of the undertaking was in all ways satisfactory, and the engineers reported that during the period under review there had been a continuous and substantial progress in every direction. The works, which up to the present time had met with the approval alike of the engineers, and, indeed, all concerned and interested in them, had been carried out without accident of any kind, and yet under very peculiar circumstances. Since the report was issued they had received a statement from the engineers, giving a most interesting account of the progress that had been made. It stated that towards the City the tunnels in July last were about 100 yards Citywards of the River Thames. They had now reached a point in Queen Victoria Street nearly opposite St. Nicholas Church, the distance driven in six months being 530 yards of double tunnel. These tunnels had been driven in the solid London clay, under the low level sewer, the Metropolitan Railway, and Queen Victoria Street, without mishap, and the rate of progress was 73 feet per week. The smaller or railway tunnels were now 400 yards distant from the commencement of the City station, which would probably be reached in June next. Towards Waterloo the tunnels were, in July last, entering Stamford Street, but as they had encountered ballast and water, and had to work under compressed air, the progress was much slower. The present rate of progress was only about 23 feet per week, and the length of double tunnel driven in this direction since the last half-yearly report was 300 yards. The contracts for the low-level station at Waterloo had been let at the engineers' estimate, and the works had been commenced. The total length of single tunnel driven since the commencement of the work was 3,036 yards, being 69 per cent. out of the total length. When this exceptional and extraordinary work, combining science and art, was completed, perhaps some member of the Royal Family might do them the honour to inaugurate them. The chairman congratulated the engineers upon the progress they had made, and also upon the wonderful immunity from accidents, and hoped things would continue to the end in the same satisfactory manner.

Lieut.-Colonel the Hon. H. W. Campbell seconded the motion.

A Shareholder said he thought the report an admirable one, and that too much could not be said either in praise of the engineers or the directors. They were fortunate in having so many members of the South-Western Board on the directorate of the Waterloo and City Company. He ventured to predict that in the course of time the Waterloo and City would become a more valuable property than even the South-Western.

The report was unanimously adopted.

Cuba Submarine Telegraph Company, Limited.

The ordinary general meeting of the Cuba Submarine Telegraph Company, Limited, was held on Wednesday, at 58, Old Broad Street, E.C., Mr. C. W. Parish, presiding.

The Chairman, in moving the adoption of the report, said the directors recommended a dividend at the rate of 8 per cent. per annum, the balance, £3,719, being carried forward. The main cables had continued in good order throughout the half-year. In consequence of the insurrection in Cuba, which still continued, the Spanish Government had suggested to the company the desirability of connecting the town of Manzanillo with one of the two existing cables running from Cienfuegos to Santiago; but as these cables were laid in 1875 and 1881 respectively, the directors considered it undesirable to disturb them. Further proposals then followed from the Government, resulting in the company obtaining a concession to lay a cable between Cienfuegos, Casilda, Tunas, Jucaro, Santa Cruz, and Manzanillo, with a subsidy of £2,000 per annum from January 1st, 1896, till August 27th, 1910, which was the date when the original concession would expire. This cable had been successfully laid by the contractors and duly taken over on behalf of the company. It was about 300 nautical miles in length, and the directors trusted that it would not only prove useful to the Government, but to the general public. The cost of the new cable, approximately about £45,000, would be charged to the reserve fund in the current half-year's accounts. In conclusion, the chairman said he thought that all things considered, they had every reason to be satisfied with the results he had placed before them, and he hoped to be able to make as satisfactory a statement at the next meeting.

Mr. G. Keith seconded the motion, and after some discussion the report was unanimously adopted.

Castner-Kellner Alkali Company, Limited.

The statutory meeting of this company was held at Cannon Street Hotel, London, on 6th inst., Mr. W. Mather presiding.

The Chairman stated that since the company was constituted, the directors had secured a very eligible site for the erection of the works at Weston Point, on the estuary of the Mersey. The building of the works had commenced this week, the contracts were placed, and the erection would be pursued with the utmost diligence during the next few months. He saw no reason to alter the favourable view he had formed many months ago, and his colleagues shared that view. Their company did not stand alone in beginning this electrolytic process in connection with a large chemical industry. One of their largest shareholders was the Deutsche Solvay Werke Gesellschaft, the directors of it having been so far satisfied with the investigations they had made in the Castner-Kellner electrolytic processes that they had not only subscribed largely to the capital of this company, but had determined to erect works in Germany simultaneously with the works which were being erected in England. They thought it desirable, at present, to confine themselves to one-fourth of the plant ultimately contemplated, and to get such advantage as time and experience would give them in a few months before proceeding with the remainder.

The City of London Electric Lighting Company, Limited.—The directors have decided to recommend to the shareholders the payment of the following dividends, subject to the completion of the audit: 6s. per share on the preference shares for the second half-year, making, with the interim dividend already paid, a total distribution of 6 per cent. for the year 1895; 10s. per share on the ordinary shares for the year 1895, being at the rate of 5 per cent. per annum. The transfer books and registers will be closed to 21st inst., inclusive.

Stock Exchange Notices.—The Committee has ordered the following to be quoted in the Official List:—Royal Electric Company of Montreal—Further issue of £34,000 sterling 4½ per cent. first mortgage debentures, Nos. 1,201 to 1,540.

Telegraph Construction and Maintenance Company, Limited.—The directors recommend a balance dividend of 10 per cent., making a total distribution of 15 per cent. for the year ended December 31st last.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending February 9th, 1896, were £972; week ending February 10th, 1895, £1,022; decrease, £50; total receipts for half-year, 1896, £5,997; corresponding period, 1895, £6,041; decrease, £44.

The Liverpool Overhead Railway Company. The receipts for the week ending February 9th, 1896, amounted to £1,090; corresponding week last year, £859; increase, £231.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending February 7th, 1896, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,848.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, Feb. 4th.	Closing Quotation Feb. 11th.	Business done during week ended Feb. 11th, 1896. Highest.	Lowest
173,400*l*	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	...	100 —104	100 —104	...	...
1,012,880*l*	Anglo-American Teleg., Ltd.	Stock	£2 11s.	£2 2s.	£2 9s.	47 — 49	47 — 49	48	...
2,993,560*l*	Do. do. 6 % Pref.	Stock	£5 2s.	£4 4s.	£4 18s.	88 — 89	88½ — 89½	89½	88¼
2,993,560*l*	Do. do. Defd.	Stock	..	...	...	7¼ — 8	7¼ — 8	...	...
130,000	Brazilian Submarine Teleg., Ltd.	10	6½% §	7 %	...	13½ — 14	14¼ — 14½	14⅜	13⅞
75,000*l*	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	110 —114	110 — 114	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	... §	2½%	...	3¼ — 3⅜	3¼ — 3⅜	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	...	160 —170	160 —170	163	162½
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % §	1½%	...	1/16 — 1/8	1/16 — 1/8	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	12½ — 13½	12½ — 13½	13 7/16	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	20½ — 21½	20½ — 21½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	10 — 10½	10 — 10½	...	...
30,000*l*	Do. do. 4½ % Debs Nos. 1 to 6,000 ...	50	...	4½%	...	104 —107 %	104 —107	...	...
60,710	Direct United States Cable, Ltd.	20	2½% §	2 %	...	8¾ — 9¼	9 — 9¼	9⅜	8 15/16
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½%	...	17 — 17½	17 — 17½	17⅛	17⅛
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 %	...	18 — 18½	18 — 18½	18⅜	18
102,100*l*	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	...	105 —108	105 —108	...	...
1,297,837*l*	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	126 —129	127 —130	129	127
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	...	17½ — 18	17½ — 18	17⅝	17⅝
54,100*l*	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	...	100 —104	100 —104	...	...
194,300*l*	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	...	101 —104	101 —104	...	...
320,000*l*	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	127 —130xd	126 —129	127½	126
80,600*l*	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	100 —104	100 —104	...	...
107,600*l*	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	101 —104	101 —104	102	...
300,000*l*	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	105 —108 xd	105 —108	...	...
200,000*l*	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	...	112 —115 %	112 —115%	112½	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅛% §	4½%	...	10 — 10½	10 — 10½	10½	10½
180,042	Do. do. 6 % Pref.	10	6 % §	6 %	...	16½ — 17	16½ — 17	17	16⅝
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜%	8⅜%	...	22 — 22½	22½ — 23	23	22⅜
180,000*l*	Do. do. do. 5 % Debs.	100	5 %	5 %	...	104 —107	104 —107	..	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	...	46 — 49	46 — 49	48½	47½
100,000*l*	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	...	107 —111	107 —111	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	...	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 %	5¼%	6⅜ — 6⅝	6½ — 6⅝	6 11/16	6½
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	16 — 18	16 — 18	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	16 — 17	16 — 17	16½	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6¼ — 6⅜	6¼ — 6⅜	...	...
1,100,000*l*	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	104 —107	104 —107	106½	105
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	4¼%	...	9/16 — 11/16	9/16 — 11/16	...	...
100,000*l*	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	...	108 —111	108 — 111	...	...
11,839	Reuter's Ltd.	8	0 %	*nil*	...	4½ — 5½	4½ — 5½	...	...
3,381	Submarine Cables Trust	Cert	...	...	...	127 —132	127 —132	130½	130
58,000	United River Plate Teleph., Ltd.	5	...	3 %	...	1¾ — 3¼	3 — 3½	...	...
146,733*l*	Do. do. 5 % Debs.	Stock	5 %	5 %	...	93 — 98	94 — 99	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	*nil*	*nil*	...	5½ — 6½	5½ — 6½	...	...
238,300*l*	Do. do. do. 5 % Debs.	100	5 %	5 %	...	101 —104	101 —104	...	...
30,000	West Coast of America Teleg., Ltd.	10	*nil*	*nil*	...	1 — 2	1 — 2	...	...
150,000*l*	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	...	94 — 99	94 — 99	...	...
64,248	Western and Brazilian Teleg., Ltd.	15	2½%	3 %	...	8⅞ — 9¼	8⅞ — 9¼	9¼	8⅞
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	...	6¼ — 6⅝	6½ — 7	6 11/16	...
33,129	Do. do. do. Def. Ord.	7½	...	1 %	...	3 — 3½	3 — 3½	...	...
165,200*l*	Do. do. do. 6% Debs "A," 1880 Red.	100	6 %	6 %	...	102 —106xd	102 —105	...	...
206,400*l*	Do. do. do. do "B," do.	100	6 %	6 %	...	102 —106xd	102 —105	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅞%	½%	...	1 — 1¼	1 — 1⅛	1⅛	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	10⅝ — 11¼	10⅛ — 11	11	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	9 — 10	9 — 10	...	...
80,000*l*	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	...	108 —111	108 —111	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	...	113 —118	113 —118	...	...
164,300*l*	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	...	102 —105	102 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	4½%	...	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	5 9/16
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	...	6⅜ — 7½	6⅜ — 7½	6¾	...
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	...	115 — 118	115 —118	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	5 %	5 %	14 — 15	14 — 15	14⅝	14½
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16 — 16½	16 — 17	16½	16⅜
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	134 —138	134 —138	...	...
22,475	County of London and Brush Prov. Elec. Ligtg., Ltd., Ord. 1—22,475	10	...	...	...	8 — 9	8 — 9	...	...
10,000	Do. do. do. 6% Pref., £8 pd., 40,001—50,000	10	...	...	...	10½ — 11	10½ — 11	10¾	...
50,000	†Liverpool Electric Supply, all paid	5	5 %	5½%	...	7⅞ — 8⅛	7⅞ — 8⅛	..	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2½%	3 %	...	11½ — 12½	12 — 12½	12⅜	12
150,000*l*	Do. 4½% first mortgage debenture stock	...	4½%	4½%	...	115 —118	115 —118	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	1 %	...	8½ — 9	8½ — 9	..	..
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	4½%	6½%	7¼%	9 — 10	9½ — 10	10	9⅝
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	9⅝	..
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	4 %	5 %	7 %	9 — 9½	9½ — 9¾	9½	9⅛

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, Feb. 4th.	Closing Quotation, Feb. 11th.	Business done during week ended Feb. 11th, 1896. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	3	5 %§	2½%	...	1 — 1¼	1 — 1¼	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 %§	3 %	...	1⅞— 1⅞	1½— 1⅝	1⅝	1 9/16
125,000£	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	4½%	...	112 —115	112 —115	114½	...
630,000£	City and South London Railway	Stock	1 1/16%	1 1/16%	1 3/16%	40 — 42 xd	40 — 42	41⅛	40¼
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	3 %§	*nil*	...	2 — 2½	2¼— 2⅜	2⅜	2
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	7 %	5 %	...	1¼— 1⅜	1½— 2	1⅞	1 9/16
17,139	Do. do. do. "A" Shares 01—017,139	5	7 %	5 %	...	3 — 4	3 — 4	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	...	4½%	...	104 —107	103 —106	102½	102
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	*nil*	...	⅝— ¾	⅝— ¾	...	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	...	2 — 2½	2 — 2½	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	¾ - 1	¾— 1	¾	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	⅝ - ¾	⅝— ¾	¾	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil*	...	¼— ⅜	¼— ⅜	...	...
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	*nil*	...	9½ - 10½	9½ — 10½		
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	6 %	...	13½— 14½	13½— 14½	14⅜	13⅞
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	...	15½ — 16½	16 — 17	16⅞	16⅜
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	...	108 —111	108 —111	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	10 %	10 %	21½— 22½	20½ - 21½	21⅜	20⅜
200,000£	Do. do. do. 4½ % Deb., 1896	100	4½%	4½%	4½%	103 —105	103 —105	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	1 %	1½%	2⅜%	12⅜ - 12½	13½— 13⅜	13¼	13⅛
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	16 — 16½	16 —16¼		
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	20 %	15 %	44 — 46	38 — 41	46	39
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —1 5	102 —105	...	...
54,000£	Waterloo and City Railway, Nos. 1 to 54,000. £4 paid ...	10	...	...	...	5 — 5¼	⅞ - ⅞	5¼	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last ividend paid was 50% for 189

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7½%; 1890—8%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5¾—6¼.

Electric Construction Corporation, 6 % Debentures, 97—102.

House-to-House Company (£5 paid), 3⅞—4¼.

Do. do. 7 % Preference, of £5, 7⅞—8¼.

Do. do. 4½% Debentures of £100, 109—111.

Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 7¼—8, 1st Preference Cumulative 6 %, £5 (fully paid), 7—7½.

Liverpool Electric Supply, £5 (fully paid), 7⅞—8¼

London Electric Supply Corporation, £5 Ordinary ⅝—¾.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares, fully paid, 6¾—7¼.

Bank rate of discount 2 per cent. (February 22nd, 1894).

MODERN APPARATUS v. EXISTING CONDITIONS.*

By W. J. BUCKLEY.

(*Concluded from page* 188.)

When the purchaser comes to buy alternating apparatus he is confronted with single-phase, quarter-phase, two-phase, three-phase, multiphase and monocyclic—surely enough to please him to start with.

But what system will fit his conditions? Which machine should he buy?

With the use of an efficient motor the single-phase is the ideal alternating current system. No condensers, no balancing of the load, no fixed arbitrary line loss, but two wires on the line, all giving a flexibility that affords a minimum cost in power, arc and incandescent services from the same machine and circuit.

All the catalogues of multiphase apparatus contain statements, variously expressed, that a single-phase synchronous motor is the most desirable but unattainable type. This is no longer true as to its unattainability. Single-phase motors are now sold on the market, having as high a commercial efficiency as is obtained in any but the large types. They are self-starting at full load with maximum torque, they require no special circuits or connections, no starting rheostat, no condenser, and no special transformer, the ordinary lighting transformer answering the purpose. Being in step with the generator, the regulation of the synchronous motor is perfect under all loads, and the motor will pull out of step and stop running if more than a 50 per cent. overload is applied.

What is a single-phase dynamo? It is a machine wherein the number of coils in the armature equal the number of pole-pieces in the field. The armature coils have the same "pitch" as the pole-pieces. The "pitch" is the distance from the centre of one field pole to the centre of the next. The coils are connected so that the armature contains but one circuit or ring of coils.

The two-phase dynamo means that there are twice the number of coils in the armature that there are poles in the field, having half the pitch of the pole-pieces. The armature is split in two, and instead of every coil being connected on one circuit, every other coil is connected together, so that the armature presents two independent circuits or rings of coils. It is practically two armatures in one field, each having its separate circuit for service.

Lamps may be tapped from either circuit and one half the armature may be cut out and the other half run on a single-phase, but all four wires comprise the power circuit and must be connected to each motor. This means four wires throughout on your poles. Both circuits may be tapped indiscriminately for light and power, but in doing so they require the same hand regulation at the station to constantly balance the load that is usually given the three-wire direct current system. Two legs of the circuit may be one wire of a nearly equal cross-section, so that the three wires require practically as much copper as the four.

In the three-phase dynamo, the armature coils are three times the number of poles and represent three separate circuits or rings of armature coils having one-third the "pitch" of the pole-pieces. The number of phases by reducing the line induction especially fit the three-phase system for the transmission of very large powers over very long distances, and the current may be delivered on not less than three and as many as six wires, depending on the fluctuations and proportioning of the load in the different services.

Monocylic is different only in the method of connecting and proportioning the armature coils, and is to all intents and purposes an unbalanced three-phase machine, unless we assume that the placing of the teaser coil in the middle of the main coil of the armature does not split these coils in two, in which case it becomes an unbalanced two-phase machine, as the teaser coil, while having wire of the same cross section, is but one-fourth the size of the main coil. The armature coils equal the number of pole pieces and are of the same "pitch," and the teaser coils being wound in the opposite direction are connected one end to the middle of the main coil circuit, the other end to the third collector ring, making a three-wire circuit, this arrangement being slightly modified to include a commutator for compounding the field to compensate for line loss.

When the dynamo is intended for lighting service only, the third wire may be dispensed with and the machine run as an ordinary single-phase machine, but with a consequent reduction in efficiency caused by the idle teaser coils.

When the dynamo is intended for power only, the three line wires must be of the same cross section, and all three wires must be in service.

When power and light are both run, the so-called teaser line wire only can be reduced in proportion to the power service, although the full cross-section of wire is usually advocated.

* Read at the annual meeting of the Northwestern Electrical Association at Milwaukee, Wis., January 15-17th, 1896.

A quarter-phase dynamo is a two-phase machine with the coils set one-fourth or 90 degrees ahead of each other.

You are all familiar with the difference of cost in erecting and maintaining two or more circuits instead of one, or three wires instead of two, but some buyers neglect the consideration of this expense until their multiphase apparatus is purchased, when it confronts them with the nasty familiarity of the unexpected expenditure so usual in disbursing our wonderfully over-estimated receipts.

Again at least one two-phase system advocates limiting the loss on line copper to two per cent.; the alternative of having a greater line loss with a small expenditure of cash for copper, is a reduction in the efficiency of the service and usually the use of condensers. It is Hobson's choice as to the amount of money required, though you might get time on apparatus, while copper is cash.

The phase affects the units in which your power is distributed. Impedance lag and idle currents develop as the size of the self-exciting motors increase, practically limiting the distribution of power on a single-phase circuit to motors not exceeding in size 100 horse-power.

The single-phase generator may be a 1,000 horse-power machine, but any one of the motors must not be larger than 100 horse-power unless independently excited and started.

So far as the phases are concerned, the only conditions under which a multiphase system is more applicable than a single-phase is in the transmission of very large amounts of power over great distances, and where the power is distributed in several units.

After the phases the important consideration is the number of alterations or the frequency.

The market apparatus of various makes gives 16,800, 15,000 and 1,200 alternations, or the product of the number of poles multiplied by the speed per minute.

An alternation is the travelling of a current through the circuit in one direction; and when it has completed its journey in the opposite direction it has made a complete period or cycle. Two alternations make a cycle, hence 16,800 alternations per minute is 8,400 cycles per minute, or 140 cycles per second; 15,000 alternations per minute, 125 cycles per second, and 7,200 alternations per minute, 60 cycles per second.

Why do different manufacturers make machines and transformers with different phases and alternations? First, the opinion is offered that it is to have something new, implying an improvement to talk up and advertise something different to that which the other fellow sells. Secondly, because low frequency machines are cheaper to build. Thirdly, because different frequencies affect in different degrees the power, incandescent and arc services.

Generally speaking, the higher the frequency the better the lighting service. The frequency of 3,600 alternations per minute, or 30 cycles per second, is suitable for power only and will not commercially operate an arc or incandescent service at all; because the low period current waves produce an undulating and decidedly fluctuating light.

Power is practically limited between 20 and 150 cycles per second, or 2,400 and 18,000 alternations per minute, because lower frequencies reduce the speed and increase the weight of motors and transformers beyond a commercial economy, while higher frequencies mechanically prevent getting the necessary number of pole pieces within an efficient compass or radius.

In the alternating arc lamp the high frequency makes an audible hum, with a distinct "pitch" of tone more or less musical; the low frequency reduces this tone "pitch" and increases the volume with but a little lessened Wagnerian effect. This noise is partially eliminated by using a special transformer for arc service only.

There is a special arc transformer on the market that will feed a steady current through the ordinary $7 carbon, dispensing with the $20 to $30 cored carbon and reducing the cost of carbons $7 per year in single carbon, $14 per year in the double carbon lamp; giving an equally good service without the use of resistance or economising coils, with their corresponding waste of energy.

Running any make of alternating arc lamp from the incandescent transformer has not yet produced a competitive arc service; and applying the known results to the plants represented in this association, the application would resolve itself into the use of the regular arc dynamo and lamp where the number of lamps exceed 40. When an alternating station has an output of a few arc lamps, by all means use the alternating arc with a spectral transformer permitting the use of the ordinary carbon, but when you can sell more than 40 arc lamps the saving of the current lost in conversion, and the single wire circuit of the regular arc system must then commend itself.

The alternations also affect the ordinary transformer. But two makers to my knowledge build a transformer especially for 7,200 alternations. All the other manufacturers build a transformer designed for high frequencies; and without altering the patterns or construction, beyond a few trivial changes to make room for the necessary added ampere turns of wire, offer a transformer presumably suitable for any frequency.

How does this affect the man who buys transformers? If he has a high frequency current, this type of transformer will consume 50 per cent. more magnetising current than one designed only for high frequency.

If he applies the high frequency transformer to the low frequency current, the lack of necessary ampere turns of wire, or weight in iron, makes the loss in magnetising current still greater, and the transformer mighty hot.

The quick repair transformer wherein the iron field is split in two, so the coils can be readily replaced, is too dear at any price, the broken magnetic circuit causing too great a loss of current in energising the transformer, apart from the charring of the insulation by the excessive heat generated.

It is an apt illustration of the eternal fitness of things that the electrical apparatus, built to repair easily, soon develops a determined disposition to accommodate you.

Summing up the brief opinions offered might suggest to the members of this association who are probable buyers of new apparatus.

1. If the amount and valuation of your money will permit, buy direct-connected apparatus.
2. If your means or present arrangement of power suggests the purchase of belt-driven dynamos, buy the heaviest slow-speed machine of the largest capacity practicable.
3. Use 2½-watt lamps; 2 watts if you can buy them.
4. If your power service is in small motors, none of which are larger than 50 horse-power, use single-phase apparatus; if in motors larger than 50 H.P. use multiphase.
5. If the proportion of lights is greater than power, buy high frequency apparatus; if power is the most important service, buy low frequency.
6. Use the largest transformer practicable having the best regulation consistent with minimum loss on no load.
7. Sell your current through meter and check up the station output with your receipts.

These suggestions numerically arranged, like the Commandments, will not be taken, I trust, as advice. Advice is the cheapest thing I know of, and I value my opinions too highly to offer them to any but those who choose to entertain them.

KASHMIR TELEGRAPHS.

Report (by Mr. H. S. Olphert, *Superintendent of Telegraphs, Kashmir Division) on Telegraph Operations in Kashmir from* 1891 *to date, with Special Report on the Condition of the Line between Srinagar and Astor after the Winter of* 1894-95.

(*Concluded from page* 190.)

25. I started with Mr. Rigby and a small party on May 7th, 1894, to open communication with Gilgit, and completed my task on May 20th, 1894. It was found that the wire had been broken in 10 places. One break was caused by snow adhering to the wire and the others by avalanches. This was comparatively little damage in a telegraph line 1?7 miles long, subject to heavy snow fall throughout its length. The snow was still deep on the passes in May, and my small party suffered a good deal, as ponies could not be used for transport, and we had to travel light. On my return to Kashmir, I submitted a special report on the condition of the line after the winter of 1893-94. (See my No. 298-C., dated June 9th, 1894.)

26. During my absence on this expedition, the line to Gulmarg was reconstructed by Mr. Hyde, sub-assistant superintendent, and on my return, I sent Mr. Rigby up to Astor to carry out the work of insulating and putting in order the line from Astor to Gilgit. Mr. Hyde was left in charge of the office and lines in the Kashmir Valley, and I collected a party to cut the forest that had been left uncut during the previous year.

27. The signallers to man the offices came up from India early in June, and were despatched to their destinations, with their office stores and furniture, as soon as transport was available for them from Bandipur. Transport was supplied by Captain W. R. Yielding, C.I.E., D.S.O., who also undertook to ration the offices according to our requirements.

28. The offices of Gurais and Minimarg had to be rationed for 12 months, and a large stock of firewood had to be collected for the supply of every one attached to these offices. Oil, furniture, medicines, and supplies of every sort had to be put into them, as they are situated in places where no local supplies could be obtained.

29. On July 12th, 1894, the line from Astor to Gilgit was formally taken over from the Kashmir State, and the line from Srinagar to Gilgit opened for traffic under the Government Telegraph Department.

30. After Mr. Rigby had insulated a portion of the line between Astor and Gilgit, it was found possible to work from Gilgit to Lahore (with Srinagar in translation), and this system of working was adopted as the usual working arrangement of the line, and proved quite successful throughout the winter. When it is remembered that under the old Kashmir system messages from Gilgit to India had, as a rule, to be repeated at Skardu, and again at Srinagar, under the most favourable conditions, and that during winter communication broke down altogether for five or six months, it must be admitted that the boon which the Government telegraph system has conferred on Gilgit is immense; messages can now be exchanged between Gilgit and Simla or Calcutta in a few hours, where formerly it took days, or, in winter, perhaps months.

31. To provide against breakdowns during the winter, a strong staff has to be maintained. The Gurais and Minimarg offices are offices of observation. Two European signallers, with two linemen and six khalasies, with a peon, sweeper and bhistie, are stationed at these offices; a similar staff is provided at Bandipur and Astor. Bunji has two native signallers, with one lineman and two khalasies and the usual office staff, and Gilgit has two European signallers, with the same line and office staff as Bunji.

32. I had some difficulty in getting the forest cutting finished, as I was unable to get the same trained wood-cutters that I had in 1893; however, I got coolies who could do the work, and it was finished in August. I had a good hospital assistant with me, but fortunately, there was not much sickness among my party in 1894, and accidents,

though pretty numerous, were not serious, except in two cases, both of which the hospital assistant pulled through successfully. One of these cases was that of a man who fell from a lofty tree about 60 feet and rolled down the Khud. He was picked up and brought into the camp of a company of the 32nd Pioneers, which was close by. They pronounced him dead, but he was carried on to my camp and, after careful nursing, recovered.

33. During the summer I altered the line in places where it had been damaged by avalanches during the winter, taking the alignment, as a rule, higher up the hill, and at the end of August I inspected the whole line up to Gilgit, returning in time to meet the Director of Telegraphs, Construction Branch, who visited Kashmir to inspect the lines.

34. In September I went up to Astor and met the Director, Construction Branch, on his way back from Gilgit, accompanying him to Bandipur, and paying a last visit to the offices along the route before winter. The Director, Construction Branch, expressed himself satisfied with the way in which the line had been constructed, and I looked forward confidently to its standing the winter storms well.

35. In October I replaced the poles on the Tragbal Pass with seasoned deodar ones, and the iron wire with a steel wire, and at the end of the month went into Srinagar for the winter. This was the first winter, since my arrival in Kashmir, that I had not to spend in camp!

36. During the year, telegraph offices were built at Gilgit and Bunji, and the line from Bunji to Jalipur was taken over from the Kashmir State in October, 1894.

37. During November and December heavy snow fell on the passes, but the line stood well between Srinagar and Astor until January 8th, 1895, when it broke down during a very severe storm, which commenced on the evening of January 5th and continued up to midnight of January 11th. This exceptional fall of snow caused numerous avalanches to rush down the hill sides between January 8th and 16th, which broke the wire in several places, and through communication was not re-established with Astor until the evening of January 18th. The men from all the offices of Bandipur, Gurais, Minimarg and Astor had to turn out on this occasion, and had to start when the weather was at its worst, with heavy snow falling, and deep soft snow to plough through. They surmounted all difficulties, did their work thoroughly, and proved the possibility of crossing the Kashmir Passes to maintain telegraph communication in the very worst weather.

38. In such weather such service is one of considerable danger, as avalanches keep constantly falling down the hill sides. Some time previous to this one of the Dâk men had been killed by an avalanche, and there had been many reports of Dâk runners having died or been frost bitten on the passes. My men therefore, when they started, had every fear of suffering the same fate; but they were well clothed, and well looked after by the telegraph signaller in charge of the parties, and I may here state that there were no casualties among the line staff throughout the winter.

39. There was no further break in communication between Srinagar and Astor until March 24th, when the line broke down in the evening during another very severe snowstorm. This storm commenced on the morning of March 22nd, culminated in a blizzard on 24th, and ceased on evening of 26th; communication was restored again on evening of March 28th, and these two breakdowns, one in January and one in March, were the only two interruptions caused by the snow on the Srinagar-Astor line, over the Tragbal and Burzil Passes, during the winter of 1894-95. All the breaks were caused by avalanches.

40. In June, 1895, I went over the line to inspect the places where breaks had occurred, and to alter the alignment so as to avoid if possible, a repetition of the damage by avalanches occurring again in the same places. I crossed the Burzil on June 21st, and then there was so much snow on the top of the pass, that laden ponies had great difficulty in getting over, after the sun had been up a few hours.

41. From Srinagar to Bandipur, about 35 miles, no damage had been done. I may mention that from the time this section of the line was erected in 1892, there have been no faults of any kind on it. From Bandipur to Zotkusu over the Tragbal Pass, 22 miles, the line had stood splendidly, the steel wire had fully answered my expectations, and had neither sagged nor broken from the weight of snow which at times adhered to it.

(1) Near Zotkusu the first break had occurred; it was caused by a huge avalanche sweeping down a nullah, and cutting away a large portion of the left bank of the nullah on which was a tree supporting the wire; the tree was carried bodily away, and the wire snapped with the strain. Permanent repairs have been effected by fixing the wire to a tree further back.

(2) The next break was about two miles further on, an avalanche rushed through the forest carrying trees and all before it, making a clear cut of about 100 feet wide through the forest, and in its course taking out a tree to which the wire was attached. This place has been spanned over.

(3) Six miles further on there had been another break, which was caused by an avalanche bursting out of its usual course and rising over the crest of a ridge on which the telegraph line had been planted. It took out some posts and carried away the wire. The village of Niel is close to this spot, and the inhabitants aver they have never seen or heard of an avalanche topping this ridge before. There is no doubt that it was an avalanche of unusual magnitude, and may never occur again. I have, however, shifted the line to some trees near the river where it is quite safe.

(4) Another break occurred near Malikadal, a mile further on. Four posts were carried away by an avalanche that swept the hill side. There was formerly no trace of an avalanche at this place. I have permanently altered the alignment here by carrying it higher up the hill side.

(5) The avalanche in the Kopuhojan nullah, a mile and a half from Malikadal, came down twice during the winter. The nullah is a deep one, and the avalanche usually keeps entirely in the nullah. This winter, however, it quite filled up the nullah and overflowed the right bank on its first descent, carrying away a post that had been planted more than 300 feet from the edge of the nullah, in a small clump of trees. The trees have been swept clear away.

(6) This break occurred when the avalanche in the Kopuhojan nullah came down the second time at the end of March. On this occasion it overflowed the left bank of the nullah, and carried away a large clump of trees of between 20 and 25 years' growth, and with them a post which had been planted in the clump, and was reasonably supposed to be quite safe. When I crossed this avalanche on June 18th, 1895, it was 1,000 feet wide under the telegraph line. It was 50 feet deep at the river's edge, and over 100 feet deep from the top of the snow to the bottom of the nullah, 50 yards from the river bank.

When an avalanche like this came down, nothing in its course will stand. It swept across the river, which, at this place, is 200 feet wide, and did great havoc among the trees on the opposite bank, blocking the river for 10 days. I have observed this avalanche after the winters of 1892-93 and 1893-94, but it has never been half as big as it was in this winter of 1894-95. In the winter of 1893-94 the line sustained no damage at this place, and the villagers say they have never seen anything like it before. I have now taken the line up the nullah, crossing where the banks are very high, and the wire is well out of reach of an avalanche of similar dimensions.

(7) For the next 13 miles the line had stood well, though avalanches were very numerous, and the next break was caused by a huge tree being brought down by an avalanche and striking the wire. The wire here has been raised 10 feet.

(8) At Zian, two miles further on, the next break occurred, and was caused by an avalanche sweeping out the post. The repairing party in the winter could only span over this break, and

(9) The avalanche came down again in March and broke the wire at the same place. I have now taken the line on to some trees higher up the hill side where no avalanche can touch it.

(10) About a mile further, near Bungla, another post was taken out by an avalanche which had overflowed its usual route in a small nullah. Here the line has been taken higher up, and is now quite safe.

(11) The next 11 miles to Minimarg office sustained no damage, though for five miles, near Mapanon, is about the worst bit of country along the whole line for avalanches. Along this stretch avalanches had come down under almost every span, but did not reach the posts, which had been planted on every available spot of rising ground. About two miles from Minimarg office a post was carried away and wire broken by an avalanche. This post was on rising ground which the avalanche topped. On careful inspection of the ground it appeared that something must have obstructed the avalanche and diverted it from its usual course. I have shifted the line here so as to be out of the way of any such similar diversion. This was the only break in the wire which occurred between Minimarg and Burzil Chowki, a distance of six miles, though four other posts were swept out by avalanches, leaving the wire intact; these places have been spanned over.

(12) Between Burzil Chowki and the top of the Burzil Pass, 4½ miles, no damage was done, and the next break occurred 2½ miles from the top of the pass, a four-stayed post was carried away, and the wire broken; this place has been spanned over; besides this, three posts were taken out by avalanches near Sirdar-ki-Koti, but the wire sustained no damage.

(13) The next break occurred about a mile below Sirdar-ki-Koti bungalow; an avalanche just reached a terminal post and broke it, at the same time snapping the wire. A slight alteration to the alignment has been made here, which will avoid a similar occurrence.

(14) Three miles further on the biggest break which occurred during the winter took place, five posts and 300 yards of wire were swept away by an avalanche, or rather by two avalanches, which came down nullahs at each end of this section, overflowed, joined in the middle, and did the damage. A couple of lengths of field cable were laid over this break in the winter, and communication was kept up through the cable from the time the break occurred in January, 1895, up to the end of June, 1895, when I altered the alignment, and permanently removed the line from a recurrence of this danger.

(15) A mile further on a post was carried away and wire broken. This break has been spanned.

(16) Near Chillum Dâk hut two posts were carried away in March, 1895, and the wire broken. This place has been made safe by spanning the break.

(17) The next 32 miles stood without damage of any sort, and the last break occurred at Bullan, 2½ miles from Astor, an avalanche coming down shot a large boulder against a post, which broke it and snapped the wire. The line here has been taken higher up the hill side.

42. Such is the record of the damage done to the telegraph line between Srinagar and Astor during the winter of 1894-95. The wire was broken altogether in 17 places; 13 of these breaks occurred during the interruption in January, 1895, and four during the interruption in March, 1895. The wire, it must be remembered, is 127 miles long, subject throughout its length to heavy snow-fall and avalanches, and all these breaks were caused by avalanches.

43. When I first came to Kashmir I was told by everyone, who knew anything about the country, that no aerial telegraph line could possibly stand on the passes, and I was strongly advised to lay a cable both over the Tragbal and Burzil. However, I felt confident that, unless something very unforeseen happened, an overhead wire, with posts properly planted, would stand on the passes, and that what we had to fear was the destructive power of avalanches in the valleys, and experience has proved the correctness of my opinion. It will be seen, from the above record of damage done, that no damage

whatever occurred on the Tragbal, and that for seven miles over the summit of the Burzil the line stood without a break.

44. The winter was one of extreme severity and long duration. In nearly every village along the route cattle and sheep died owing to their owners not having laid in sufficient fodder to last through the winter; they had calculated only for the requirements of an ordinary winter, and were not prepared for one which lasted several weeks longer than usual. The snowstorms were heavy, and the avalanches were very numerous, and remarkable for their size, and the unusual places in which many of them occurred. During the winter of 1893-94 nine breaks were caused by avalanches, and it is satisfactory to note that in no place where the alignment was altered last year, has any damage been done during the winter of 1894-95. We may therefore hope in time to eliminate the chances of a break occurring even by avalanches which leave their usual course, and if the avalanches keep the courses they took in 1893-94 and 1894 95, we may hope to get through the winter of 1895 96 without a break.

45. Our first working year on the Srinagar-Gilgit line has now terminated, and I think we may look back on it with satisfaction as far as the question of maintaining telegraphic communication with Gilgit is concerned. During the Chitral expedition and the events which led up to it, this line must have rendered good service to the Government of India, and during the winter months, both for official and private correspondence, it was much used, as the postal service could not be depended on.

H. S. Olphert,
Superintendent of Telegraphs, Kashmir Division.

Camp through Bandipur, *July 19th*, 1895.

ELECTRIC TRAMWAY AT AIX LA CHAPELLE.

At a recent meeting of the Aix la Chapelle district Society of the Verein Deutscher Ingenieure, Mr. F. Haselmann, director of the local light railway company, presented a paper descriptive of this system of electric tramways. The paper, of which a reproduction is given in the *Elektrotechnische Zeitschrift*, is interesting as showing the advantages of utilising the existing municipal electric light station for supplying the current for the working of the tramways.

A length of 26 kilometres of line equipped with 34 motor cars, was set in operation in August of last year. These comprise four lines, but three others of 12 kilometres in length, have already been put in hand. All the lines prior to the conversion to the electric system, were of single track and of normal German gauge, for two horses to run between the metals. But on deciding to adopt electric traction, the lines were reconstructed and laid to 1 metre gauge. The cost of conversion and electrical equipment of the 26 kilometres (of which 2 kilometres are double track) was as follows:—

Reconstruction of track of old sections and new track for extensions	£15,000
Constructive work at the central station	1,750
Motor cars (34)	18,250
Overhead installation	10,000
Total	£45,000

An important saving was effected by connecting the tramway system with the municipal electric light station. If this arrangement had not been entered into, the provision of an independent power station, including the cost of the site, would have cost approximately between £20,000 and £22,500. The increase in the company's capital was so great that an extension of the concession became necessary, in order to provide for the redemption of the capital. That extension was granted, but several years will elapse before the expenditure of conversion will be met by the saving in the cost of working.

The steam engines at the generating station are of the compound condensing type made by Mr. G. Kuhn, of Stuttgart-Berg. They are two in number, having a guaranteed efficiency of 85 per cent. At normal load—180 H.P. for each engine—this is sufficient for dealing with the regular working of the cars on weekdays; but on Sundays and holidays the demand for power reaches 480 H.P., being the combined maximum output of the two steam engines. As reserve a rotary transformer or motor generator is used. The motor receives current from the lighting network at 220 volts, whilst the generator gives current at 550 volts. This motor generator, which will furnish 150 kilowatts, is equivalent to one of the tramway generating dynamos. Steam is supplied to the engines by two boilers constructed for a working pressure of 180 lbs.

The dynamos, which are of the Schuckert type, are coupled direct to the engines. The efficiency of these machines is 92 per cent. The current is led to the trolley wires by means of feeders which are so dimensioned that the same pressure exists at full load at their points of connection with the trolley wire. The trolley wire is supported by means of masts and span wires and wall brackets.

The gradients in Aix la Chapelle are heavy, rising to as much as 90 metres in 1,000. In consequence of this, 15 of the cars have each been equipped with two motors of from 15 H.P. to 20 H.P. The motors drive the axles by means of simple toothed gear, which runs in an oil bath.

BOARD OF TRADE ELECTRIC LIGHTING REGULATIONS.

Electric Lighting Acts, 1882 and 1888.

Order, 18.

Board of Trade Regulations:—

(A), for securing the safety of the public, and
(B), for ensuring a proper and sufficient supply of electrical energy.

Definitions.

In the following regulations the expression "the Order" means the Order,

The expression "the undertakers" means the undertakers for the purposes of the order.

The expression "consumer's wires" means any electric lines on a consumer's premises which are connected with the service lines of the undertakers at the consumer's terminals.

The expression "aerial line" means any electric line which is placed above ground and in the open air.

The expression "pressure" means the difference of electrical potential between any two conductors through which a supply of energy is given, or between any part of either conductor and the earth; and

(*a*) Where the conditions of the supply are such that the pressure may at any time exceed 500 volts if continuous, or 250 volts if alternating, but cannot exceed 3,000 volts, whether continuous or alternating, the supply shall be deemed a high pressure supply:

(*b*) Where the conditions of the supply are such that the pressure may on either system exceed 3,000 volts, the supply shall be deemed an extra high pressure supply.

The expressions "high pressure" and "extra high pressure" respectively are used in relation to electric lines, conductors, circuits, and apparatus, according to the conditions of the supply delivered through the same or particular portions thereof.

Where these regulations require any metallic body to be "efficiently connected with earth," it shall be connected with the general mass of earth in such manner as will ensure at all times an immediate and safe discharge of electrical energy.

Other expressions to which meanings are assigned in the order or in the above-mentioned Acts have the same respective meanings in these regulations.

A.—Regulations for Securing the Safety of the Public.

General.

Pressure of supply to consumers. (1) The pressure of a supply delivered to any consumer shall not exceed 250 volts at any pair of terminals, except with the express approval of the Board of Trade. Such approval will only be given for special purposes and on the joint application of the consumer and the undertakers, and the supply will be subject to such further regulations as the Board of Trade may from time to time prescribe.

Pressure of supply to transforming apparatus. (2.) The pressure of a supply delivered to a transforming station or to transforming apparatus on a consumer's premises may exceed 250 volts, but shall not exceed the limits of high pressure.

Limitations of extra high pressure supply. (3) An extra high pressure supply shall not be given except to distributing stations or other premises in the sole occupation of the undertakers, and with the written consent of the Board of Trade, and subject to such regulations and conditions as the Board may prescribe.

Maximum current in conductors. (4.) The maximum working current in any conductor shall not be sufficient to raise the temperature of the conductor or any part thereof to such an extent as to materially alter the physical condition or specific resistance of the insulating covering, if any, or in any case to raise such temperature to a greater extent than 30° Fahr.; the cross sectional area and conductivity at joints must be sufficient to avoid local heating, and the joints must be protected against corrosion.

Minimum size of conductors. (5.) The sectional area of the conductor in any electric line laid or erected in any street, after the date of these regulations, shall not be less than the area of a circle of $\frac{1}{10}$th of an inch diameter, and where the conductor is formed of a strand of wires, each separate wire shall be at least as large as No. 20 standard wire gauge.

Specification of insulating material. (6.) All material used for insulating electric lines or apparatus shall be of the best quality, and thoroughly durable and efficient, having regard to the conditions of its use. Suitable provision shall be made for the protection of the insulating material against injury or removal.

If the protection so provided be wholly or partly metallic, it shall be efficiently connected with earth.

Insulation test of electric lines. (7.) Every main shall be tested for insulation after having been placed in position, and before it is used for the purposes of supply, the testing pressure being at least 200 volts, and the undertakers shall duly record the results of the tests of each main or section of a main.

Maintenance of Insulation. (8.) The insulation of every complete circuit used for the supply of energy, including all machinery, apparatus, and devices forming part of, or in connection with, such circuit, shall be so maintained that the leakage current shall not, under any conditions, exceed one-thousandth part of the maximum supply current: and suitable means shall be provided for the immediate indication and localisation of leakage.

Every leakage shall be remedied without delay.

Every such circuit shall be tested for insulation at least once in every week, and the undertakers shall duly record the results of the testings.

Provided that where the Board of Trade have approved of any part of any electric circuit being connected with earth, the provisions of this regulation shall not apply to that circuit so long as the connection with earth exists.

High pressure conductors to be covered. (9.) Every high pressure conductor laid after the date of these regulations shall be continuously covered with insulating material to a thickness of not less than $\frac{1}{100}$th part of an inch, and in cases where the extreme difference of potential in the circuit exceeds 2,000 volts, the thickness of insulating material shall not be less in inches, or parts of an inch, than the number obtained by dividing the number expressing the volts by 20,000.

Testing of insulation of all parts of any high pressure circuit. (10.) A high pressure circuit shall not be brought into use unless the insulation of every part thereof has withstood the continuous application, during one hour, of pressure exceeding the maximum pressure to which it is intended to be subjected in use, that is to say, in the case of every electric line a pressure twice the said maximum pressure, and in the case of every machine, device, or apparatus, a pressure 50 per cent. greater than the said maximum pressure.

The undertakers shall duly record the results of each test.

Quick-acting cut-off for high pressure lines, &c. (11.) Every high pressure electric line, conductor, or other apparatus shall be protected by a suitable automatic quick-acting cut-off.

Provided that it shall not be incumbent upon the undertakers to provide such a cut-off for the outer conductor of a concentric main which is, with the approval of the Board of Trade, efficiently connected with earth.

Transformers. (12.) In every case where a high pressure supply is transformed for the purpose of supply to one or more consumers, some suitable automatic and quick-acting means shall be provided to protect the consumer's wires from any accidental contact with or leakage from the high pressure system, either within or without the transforming apparatus.

Limit of power in high pressure electric line. (13.) A high pressure electric line shall not be used for the transmission of more than 300,000 watts, or in the case of an aerial line 50,000 watts, except with the consent in writing of the Board of Trade, and efficient means shall be provided to prevent this limit being at any time exceeded.

Protection from lightning. (14). Where any portion of any electric line, or any support for an electric line, is exposed in such a position as to be liable to injury from lightning, it shall be efficiently protected against such injury.

Accidents to be reported. (15.) Where any accident by explosion or fire, or any other accident of such kind as to have caused, or to be likely to have caused, loss of life, or personal injury has occurred at any part of any electric line or work, the undertakers shall give immediate notice thereof to the Board of Trade.

Aerial Lines where erected with the necessary Consents.

Maximum intervals between supports. (16.) Every aerial line shall be attached to supports at intervals not exceeding 200 feet wide where the direction of the line is straight, or 150 feet where the direction is curved, or where the line makes a horizontal angle at the point of support.

Supports, construction and erection of. (17.) Every support of an aerial line shall be of a durable material, and properly stayed against forces due to wind pressure, change of direction of the line, or unequal lengths of span. The factor of safety shall be for aerial lines and suspending wires at least 6, and for all other parts of the structure at least 12, taking the maximum possible wind pressure at 50 lbs. per square foot. No addition need be made for a possible accumulation of snow.

Every support, if of metal, shall be efficiently connected with earth.

Attachment of aerial lines. (18.) Aerial lines shall be attached to insulators, and shall be so guarded that they cannot fall away from the support. Conductors covered with insulating material shall not be attached to the insulators by uninsulated metal binders.

Height from ground and distance from buildings, &c. (19.) An aerial line shall not in any part thereof be at a less height from the ground than 18* feet, or where it crosses a street, 30* feet, or within 5 feet measured horizontally, or 7 feet measured vertically, from any building or erection other than a support for the line, except where brought into a building for the purpose of supply.

Service lines from aerial lines. (20.) Service lines from aerial lines shall be led as directly as possible to insulators firmly attached to some portion of the consumer's premises which is not accessible to any person without the use of a ladder or other special appliance, and from this point of attachment they shall be enclosed and protected in accordance with the subsequent regulations as to electric lines on the consumer's premises. Every portion of any service line which is outside a building, but is within 7 feet from the building, shall be completely enclosed in stout India-rubber tubing.

Angle of crossing thoroughfares. (21.) Where an aerial line crosses a street, the angle between the line and the direction of the street at the place of crossing shall not be less than 60°, and the spans shall be as short as possible.

* Note.—In the County of London, 20 feet and 35 feet.

Crossing wires, &c. (22.) Where an aerial line crosses, or is in proximity to, any metallic substance, precautions shall be taken by the undertakers against the possibility of the line coming into contact with the metallic substance, or of the metallic substance coming into contact with the line by breakage or otherwise.

Suspending wires. (23.) Every high pressure aerial line shall be efficiently suspended by means of insulating ligaments to suspending wires, so that the weight of the line does not produce any sensible stress in the direction of its length. All suspending wires, if of iron or steel, shall be galvanised.

Discharge of pressure in case of fire. (24.) In the case of any high pressure aerial line exceeding one half mile in total length, means shall be provided whereby the pressure may be discharged from any portion of the line erected over or alongside of any building or buildings without loss of time in case of fire or other emergency.

Maintenance. (25.) Every aerial line, including its supports and all the structural parts and electrical appliances and devices belonging to or connected with the line, shall be duly and efficiently supervised and maintained as regards both electrical and mechanical conditions.

Unused aerial lines to be removed. (26.) An aerial line shall not be permitted to remain erected after it has ceased to be used for the supply of energy, unless the undertakers intend within a reasonable time again to take it into use.

Electric Lines other than Aerial Lines.

Construction of receptacles for electrical lines. (27.) All conduits, pipes, casings, and street boxes used as receptacles for electric lines shall be constructed of durable material, and where laid under carriage ways shall be of ample strength to prevent damage from heavy traffic; and reasonable means shall be taken by the undertakers to prevent accumulation of gas in such receptacles.

Crossing pipes, &c. (28.) Where any electric line crosses, or is in proximity to any metallic substance, special precautions shall be taken by the undertakers against the possibility of any electrical discharge to the metallic substance from the line or from any metal conduit pipe or casing enclosing the line.

Electric continuity of metal conduits, pipes, or casings. (29.) All metal conduits, pipes, or casings containing any electric line shall be efficiently connected with earth; and shall be so jointed and connected across all street boxes and other openings as to make good electrical connection throughout their whole length.

Precautions against charging of short lengths of pipe, &c. (30.) Where isolated lengths of metal conduit, pipe, or casing are used for the protection of any electric line at road crossings or similar positions, special precautions shall be taken to prevent the possibility of any electrical charging thereof.

Precautions to be taken when bare conductors are used. (31.) Where the conductors of electric lines placed in any conduit are not continuously covered with insulating material, they shall be secured in position, and no unfixed uninsulated material of a conducting nature shall be contained in the conduit. No such conductor shall be at a higher potential than 300 volts.

Adequate precautions shall also be taken to ensure that no accumulation of water shall take place in any part of the conduit, and to prevent any dangerous access of moisture to the conductors or the insulators.

In the case of any such electric lines laid in conduits after the date of these regulations, the insulators shall be so disposed that they can be readily inspected.

High pressure lines laid above ground. (32.) Every portion of any high pressure electric line placed above the surface of the ground, or in any subway not in the sole occupation of the undertakers, shall be completely enclosed either in a tube of highly insulating material embedded in brickwork, masonry, or cement concrete, or in strong metal casing efficiently connected with earth.

High pressure lines laid in proximity to other electric lines or to the surface of the ground. (33.) Where any high pressure electric line is laid beneath the surface of the ground, efficient means shall be taken to render it impossible that the surface of the ground or any neighbouring electric line or conductor shall become charged by leakage from the high pressure electric line.

Street Boxes.

Street boxes. (34.) In addition to the provisions contained in Regulation 27 as to the construction of receptacles for electric lines, the following regulations shall be observed with respect to the construction of street boxes:—

(*a*) The covers of all street boxes shall be so secured that they cannot be opened except by means of a special appliance.

(*b*) The covers of all street boxes containing high pressure apparatus, other than cables, shall be connected to strips of metal laid immediately underneath the adjacent roadway, and efficient means shall be taken to render it impossible that the covers or other exposed parts of these boxes, or any adjacent material forming the surface of the street, shall become electrically charged, whether by reason of leakage, defect, or otherwise.

(*c*) Where street boxes are used as transformer chambers, reasonable means shall be taken to prevent as far as possible any influx of water, either from the adjacent soil or by means of pipes, and in the case of any such street box exceeding 1 cubic yard in capacity, ample provision shall be made, by ventilation or otherwise, for the immediate escape of any gas which may by accident have obtained access to the box, and for the prevention of danger from sparking.

(*d*) All street boxes shall be regularly inspected for the presence of gas, and if any influx or accumulation is discovered, the undertakers shall give immediate notice to the authority or company whose gas mains are laid in the neighbourhood of the street box.

Transforming Stations.

Transforming stations. (35.) Transforming stations, or points in a system of distribution, in which a high pressure supply is transformed for the purpose of supply to consumers, and which are not on the consumer's premises, shall be established in suitable places which are in the sole occupation and charge of the undertakers.

Consumer's Premises.

Responsibility of undertakers for their lines, &c., on consumer's premises. (36.) The undertakers shall be responsible for all electric lines, fittings, and apparatus belonging to them, or under their control, which may be upon a consumer's premises, being maintained in a safe condition and in all respects fit for supplying energy.

Fire risks. (37.) In delivering the energy to a consumer's terminals, the undertakers shall exercise all due precautions, so as to avoid risk of causing fire on the premises.

Main fuses or disconnectors to be provided in a locked receptacle. (38.) A suitable safety fuse or other automatic disconnector shall be inserted in each service line within a consumer's premises as close as possible to the point of entry, and contained within a suitable locked or sealed receptacle of fireproof construction, except in cases where the service line is protected by fuses in a street box.

Treatment of electric lines and apparatus on consumer's premises. (39.) All electric lines and apparatus placed on a consumer's premises shall be highly insulated and thoroughly protected against injury to the insulation or access of moisture, and any metal forming part of the electric circuit, shall not, unless efficiently connected with earth, be exposed so that it can be touched. All electric lines shall be so fixed and protected as to prevent the possibility of electrical discharge to any adjacent metallic substance.

Transformers and high pressure apparatus to be enclosed in metal. (40.) Where the general supply of energy is a high pressure supply, and transforming apparatus is installed on a consumer's premises, the whole of the high pressure service lines, conductors and apparatus, including the transforming apparatus itself, so far as they are on the consumer's premises, shall be completely enclosed in solid walls, or in strong metal casing efficiently connected with earth, and securely fastened throughout.

Connection to consumer not to be made where leakage would result. (41.) The undertakers shall not connect the wires and fittings on a consumer's premises with their mains unless they are reasonably satisfied that the connection would not cause a leakage from those wires and fittings exceeding one ten-thousandth part of the maximum supply current to the premises; and where the undertakers decline to make such connection, they shall serve upon the consumer a notice stating their reasons for so declining.

Discontinuance of supply on discovery of leakage on consumer's premises. (42.) If the undertakers are reasonably satisfied, after making all proper examination by testing or otherwise, that a leakage exists at some part of a circuit of such extent as to be a source of danger, and that such leakage does not exist at any part of the circuit belonging to the undertakers, then and in such case any officer of the undertakers, duly authorised by them in writing, or, if the undertakers so require, an electric inspector may, for the purpose of discovering whether the leakage exists at any part of a circuit within or upon any consumer's premises, by notice require the consumer at some reasonable time, after the service of the notice, to permit him to inspect and test the wires and fittings belonging to the consumer, and forming part of the circuit.

In any case where the undertakers require the services of an electric inspector under this regulation, they shall pay him the prescribed fee.

If, on such testing, the officer or the electric inspector discovers a leakage from the consumer's wires exceeding one ten-thousandth part of the maximum supply current to the premises, or if the consumer does not give all due facilities for inspection and testing, the undertakers shall forthwith discontinue the supply of energy to the premises in question, giving immediate notice of the discontinuance to the consumer, and shall not recommence the supply until they are reasonably satisfied that the connection with earth has been removed. This regulation shall not affect any power contained in the order, or otherwise enabling the undertakers to discontinue the supply.

Appeal to electric inspector. (43.) If any consumer is dissatisfied with the action of the undertakers in refusing to give, or in discontinuing or in not recommencing the supply of energy to his premises, the wires and fittings of that consumer may, on his application, and on payment of the prescribed fee, be tested for the existence of leakage by an electric inspector.

This regulation shall be endorsed on every notice given under the provisions of either of the two last preceding regulations.

Arc Lighting.

Arc lamps to be guarded. (44.) All arc lamps shall be so guarded as to prevent pieces of ignited carbon or broken glass falling from them, and shall not be used in situations where there is any danger of the presence of explosive dust or gas.

Height from ground. (45.) Arc lamps used in any street for public lighting shall be so fixed as not to be in any part at a less height than 10 feet from the ground.

Cut-off switch. (46.) Arc lamps used in any street for private lighting shall be fixed so as not to be in any part at a less height than 8 feet from the ground, and shall be so screened as to prevent risk of contact with persons. A cut-off switch, fixed in a suitable locked receptacle, shall be provided for every high pressure arc lamp, and such switch shall be of such pattern and construction as will provide:—

(*a*) That the lamp can by its means be entirely disconnected from the supply circuit;

(*b*) That the switch itself can be safely operated in the dark without special precautions; and

(*c*) That there shall be no danger of any injurious electrical arcing, sparking, or heating being caused by the operation of the switch.

Penalties for default. (47.) If the undertakers make default in complying with any of the preceding regulations, they shall, on conviction, be liable to a penalty not exceeding £10 for every such default, and to a daily penalty not exceeding £10.

The recovery of a penalty under these regulations shall not affect the liability of the undertakers to make compensation in respect of any damage or injury which may be caused by reason of the default.

B.—REGULATIONS FOR SECURING A PROPER AND SUFFICIENT SUPPLY OF ELECTRICAL ENERGY.

Notice of intention to supply through mains. (1.) Forty-eight hours at least before the undertakers are ready to commence to supply energy through any feeding, charging, or distributing main, they shall serve a notice upon the local authority of their intention to commence such supply.

Undertakers to provide constant supply. (2.) From and after the time when the undertakers commence to supply energy through any distributing main, they shall maintain a supply of sufficient power for the use of all the consumers for the time being entitled to be supplied from such main; and such supply shall, except so far as may be otherwise agreed upon from time to time between the local authority and the undertakers, be constantly maintained. Provided that, for the purposes of testing, or for any other purposes connected with the efficient working of the undertaking, the authority by whom the electric inspector is appointed may give permission to the undertakers to discontinue the supply at such intervals of time and for such periods as that authority may think expedient. When the supply is so discontinued, notice of such discontinuance, and of the probable duration thereof, shall be forthwith served upon the local authority.

Provisions as regards stoppage. (3.) The system of distributing mains shall be so arranged that in any case it becomes necessary to stop the supply through any portion of a main for more than one hour, for the purposes of repairs, or for any other reason, the stoppage of supply will in no case exceed in amount a maximum power of 200,000 watts, or extend to the premises of more than 80 consumers, and in the case of every stoppage for more than one hour reasonable notice shall be previously given by the undertakers to every consumer affected thereby except in cases of emergency.

Pressure in mains during supply. (4.) During the whole of the period when a supply of energy is required to be maintained by the undertakers in the distributing mains under the order and these regulations, it shall be maintained at a constant pressure in these regulations termed the "standard pressure"; but the standard pressure may be different for different portions of the distributing mains. Provided that the undertakers shall be deemed to have complied with the requirements of this regulation so long as the pressure does not at any point vary more than 2 per cent. from the corresponding standard pressure in the case of a general supply at high pressure or 3 per cent. in other cases, unless changes in pressure recur so frequently as to cause unsteadiness in the supply.

Fixing of standard pressure. (5.) The standard pressure shall be fixed by the undertakers, and notice of the amount of such standard pressure shall be given to the local authority before the undertakers commence to supply energy to consumers, and such standard pressure shall not be altered except by permission of the local authority, and upon such terms and conditions as the local authority may impose, and after public notice has been given during a period of one month, in such manner as the local authority may require, of the intention of the undertakers to apply for permission to alter the same. The undertakers may appeal against any decision of the local authority under this regulation to the Board of Trade, whose decision shall be final.

Declared pressure at consumer's terminals. (6.) Before commencing to give a supply of energy to any consumer, the undertakers shall declare to such consumer the constant pressure at which they propose to supply energy at his terminals. The pressure so declared at any pair of consumer's terminals shall not at any time be altered or departed from, except in consequence of any authorised alteration of the corresponding standard pressure. In the case of a transformation of energy on the consumer's premises, the undertakers shall give the consumer the choice of a supply at either of two different pressures, one of which shall be approximately half the other, and in such case the pressure so chosen by the consumer shall be the declared constant pressure.

Provided that no change shall be made in the pressure of the supply to any premises which, at the date of these regulations, are supplied with energy by the undertakers, except with the consent of the consumer.

Variation of pressure at consumer's terminals. (7.) The variation of pressure at any consumer's terminals shall not, under any conditions of the supply which the consumer is entitled to receive, exceed 4 per cent. from the declared constant pressure.

Penalty for default.

(8.) If the undertakers make default in complying with any of these regulations as to supply, they shall, subject to the provisions of the order, be liable, on conviction, to a penalty not exceeding £5 for every such default, and to a daily penalty not exceeding £5.

These regulations are made subject to the power of the Board of Trade to make such further or other regulations as they may think expedient; and nothing in these regulations shall be construed to authorise the undertakers to lay any electric line or work their undertaking otherwise than in accordance with the order and the principal Act, or to supply energy otherwise than by a system, for the time being, approved of by the Board of Trade under the order.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents*, 31, *High Holborn, London, W.C., to whom all inquiries should be addressed. Copies of any of the specifications may be obtained of* Messrs. W. P. Thompson & Co., *price, post free*, 8½*d.* (*in stamps.*)]

EXPIRED PATENTS.

We are informed by Messrs. W. P. Thompson & Co. that 60 applications for electrical patents were filed in the month of February, 1882. Of these a large number were never completed and of those that were completed not one has been maintained to run its full term of 14 years. One patent ran for 13 years, expiring last February, all the others were abandoned after the lapse of a few years.

NEW PATENTS.—1896.

1,848. "Improvements in electric velocipedes and other vehicles electrically driven." C. Adams-Randall. Dated January 27th.

1,860. "Improvements in the method of and means for protecting electric lamp fittings from corrosion and for preventing short-circuiting." J. L. Kendal. Dated January 27th.

1,867. "Improvements in apparatus for straining electrical conductors in culverts." S. W. Baynes. Dated January 27th.

1,888. "Improvements in dynamo-electric machines." S. Z. de Ferranti. Dated January 27th.

1,905. "Improvements in furnace-blasts, and in process and in means or apparatus for electro-thermally treating materials, for the reduction of metals, production of carbides, acetylene, cyanogen, cyanides, nitrides, and the fixation of nitrogen." H. Maxim. Dated January 27th.

1,927. "Improvements in electric railway systems." M. L. Wood. Dated January 27th.

1,958. "Improvements in and relating to electric gas-lighters and extinguishers, and the like." J. T. Armstrong and C. G. G. Braunerhjelm. Dated January 28th.

1,963. "A new or improved electrical switch." S. Glover. Dated January 28th.

1,979. "Improvements in conduits for conductors of electricity." W. H. Lane. Dated January 28th.

1,992. "Improvements in electric arc lamps." E. J. Bagnall and G. Arnold. Dated January 28th.

2,003. "Improvements in telegraph repeaters." H. H. Lake. (B. F. Merritt, United States.) Dated January 28th.

2,029. "An improvement in electric glow lamps." R. B. Roxby. Dated January 28th.

2,043. "Improvements in multiple telegraphy." T. B. Dixon. (Date applied for under Patents, &c., Act, 1883, Section 103, September 12th, 1895, being date of application in United States.) Dated January 28th.

2,051. "Improvements in electrical resistance thermometers." H. R. J. Burstall and H. F. W. Burstall. Dated January 29th.

2,053. "Improvements in so-called uni-polar dynamos for generating continuous electric currents, applicable also to continuous current motors and continuous current transformers." L. W. Heath. Dated January 29th.

2,056. "Improvements in and connected with magneto-electric machines for electrically lighting cycles and other vehicles." R. Bryan-Haymes, H. E. C. Walcott, J. B. Collier, and E. G. Bryant. Dated January 29th.

2,074. "Improvements in the construction of lamp and bracket reflectors for electric, gas, and other lights." J. Parker. Dated January 29th.

2,106. "Improvements in lightning dischargers for electrical installations." Siemens Bros. & Co., Ltd. (Siemens & Halske, Germany.) Dated January 29th.

2,107. "Improvements in telephones." J. Imbay. (La Société Anonyme pour la transmission de la force par l'electricité, France.) Dated January 29th.

2,176. "Preserving meat by the help of electricity." A. B. Pinto. Dated January 30th.

2,194. "Improved means, applicable for use in electric arc lighting, for regulating the distance between the carbon points." O. Bondy and A. Jordan. Dated January 30th.

2,197. "An improvement in the preparation of electrolysed chloride solutions for disinfecting and like purposes." E. Hermite, E. J. Paterson, and C. F. Cooper. Dated January 30th.

2,199. "Improvements in apparatus for transforming alternating into continuous electrical currents or conversely." J. Imbay. (La Société Anonyme pour la transmission de la force par l'electricité, France.) Dated January 30th.

2,224. "Improvements in prepayment mechanism for electrical or other meters." C. O. Bastian and H. C. Hodges. Dated January 30th.

2,233. "Improvements in the combination of writing tubes and incandescent lamps." C. Baker. Dated January 31st.

2,248. "Improvements in electrical cut-outs." H. Hirst. Dated January 31st.

2,249. "Improvements in and connected with fuses for electrical cut-outs." H. Hirst. Dated January 31st.

2,254. "New or improved electrical appliance for extracting broken drills from bore-holes." F. Walker and W. C. Sanderson. Dated January 31st.

2,285. "An improved method of manufacturing refined bitumen for asphalte, electrical and other purposes. C. W. Bradshaw and H. A. H. Moore. Dated January 31st.

2,324. "An improved electric coupling." J. H. Tucker. Dated February 1st.

2,328. "Improvements in hanging lamps for gas, oil, or electric light." J. B. Bruce. Dated February 1st.

2,335. "Improvements applicable to electric meters." W. McWhirter. Dated February 1st.

2,337. "Improved means for use in working apparatus by electricity." G. E. Sautter and H. Harle. Dated February 1st.

2,348. "Improvements in electric switches." J. M. Huisman and H. C. Gover. Dated February 1st.

2,382. "Improvements in dynamometers." H. H. Lake (G. W. Lewin, United States).

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

1895.

20,214. "Improvements in tubular galvanic batteries." E. S. Boynton. Dated October 26th. The elements are enclosed in a tubular casing, the positive and negative elements being directly connected through the medium of the liquid electrolyte common to all the elements, and which extends throughout the continuous chamber. The casing is made of open ended hollow rings on carbon, placed end to end and insulated from each other by washers. 4 claims.

20,215. "Improvements in double fluid galvanic batteries." E. S. Boynton. Dated October 26th. The battery is composed of an outer vessel containing the liquid electrolyte, in which are placed a number of cells, each comprising a cup of impervious material having an aperture for the electrolyte to pass through. Within this outer cup there is another inner cup and an electrode in both cups. The cells are connected in series. 2 claims.

20,431. "Improvements in secondary batteries." J. J. Rooney. Dated October 29th. A battery plate is formed of a paper board perforated and suitably treated. The holes are filled with absorptive material forming pellets. These may be respectively connected to the positive and negative terminals so that adjacent rows of pellets when charged will be of contrary polarity, or all pellets in one grid may be connected together to form a single positive or negative element. 9 claims.

20,807. "Process for the production of electrotypes or galvanos with engraved or sunk drawings or designs." R. Mayer. Dated November 4th. A pen and ink drawing is photographed, and a transfer print prepared from the negative. This print is then transferred to a metal plate which is etched in the usual manner. Autotypes may be similarly prepared on a grid surface. 1 claim.

20,883. "Improvements in telephone and other electric systems." P. M. Justice. (W. H. Nixon, U.S.A.) Dated November 5th. Is a system of wiring consisting of three parallel conductors, two of which are normally open in one direction but at opposite ends of the system, and the third connects the other ends of the open conductors. Open branch loops are provided at various points of the normally open conductors by which an instrument may be inserted between these conductors, while one or more instruments are inserted in the third conductor. Means are also provided for connecting one or both of the open conductors at its open end with the other open conductors. 3 claims.

22,004. "Improvements in or relating to electrical conduits." J. F. Cummings and W. C. Yawkey. Dated November 19th. This conduit is specially designed for high tension currents. The construction embodies one or more ducts connecting into junction boxes or otherwise divided into sections, with a new hardening fluid insulation surrounding the conductor, so arranged that from any desired section of duct or conduit the liquid can be withdrawn and the conductor removed without disturbing the remaining sections. A special construction of valve for controlling the ends of the ducts is also described. 8 claims.

22,066. "Improvements in two-way switches." B. M. Drake and J. M. Gorham. Dated November 20th. A quick break switch. Two pairs of contact jaws are provided opposite each other. A slipper of insulating material has wedge shaped ends for taking into the jaws. Through the centre of the slipper passes a spiral spring so arranged that it tends to force the slipper into either of the jaws. A clutch is provided for actuating the slipper. 3 claims.